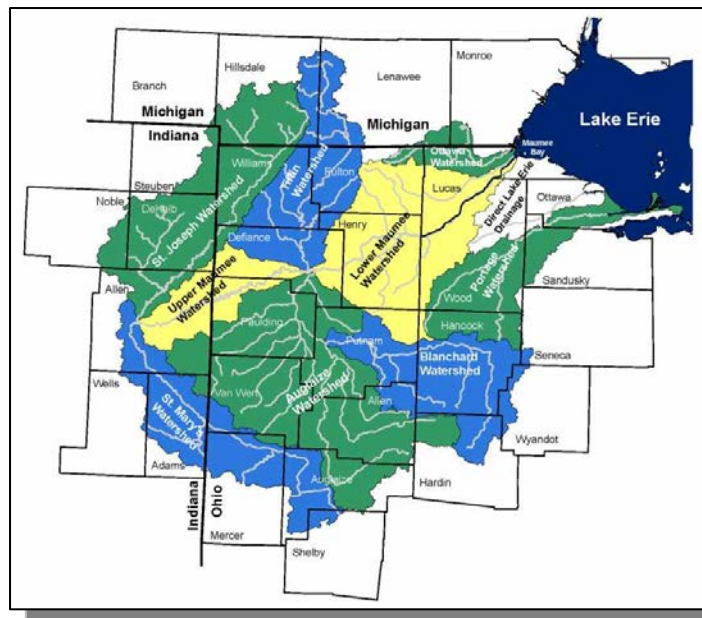




Western Lake Erie Basin Study Maumee Bay Watershed Assessment

Final
August 3, 2009



**US Army Corps
of Engineers**

Buffalo District
1776 Niagara Street, Buffalo, NY 14207

EXECUTIVE SUMMARY

Introduction: The Maumee Bay project area consists of the area loosely bound by Toledo Harbor, Woodtick Peninsula and Little Cedar Point. Maumee Bay is influenced by inflow from the Maumee and Ottawa Rivers and Lake Erie.

Toledo Harbor is located on the southwestern shore of Lake Erie at the mouth of the Maumee River in Lucas County, Ohio. It is an active and established domestic and international port along the Great Lakes and St. Lawrence Seaway System.

The Maumee and Ottawa River watersheds collectively comprise approximately 4.2 million acres. Sediment and other pollutant loading from these rivers are a significant source to Maumee Bay and Lake Erie. Maumee Bay is shallow and substantial shoaling occurs. Significant amounts of sediment must be dredged periodically from the harbor channels and appropriately disposed of in order to maintain navigational channels important to the local and regional economy.



Figure E-1. Satellite view of Maumee Bay and algae plume.

Lake Erie, Maumee Bay, and the Maumee and Ottawa Rivers support diverse fish and wildlife habitat and populations. The natural resources of the harbor and urban areas have been degraded in the past due, in part, to urban development and related point and non-point discharge of contaminants. Water clarity, algal blooms, nutrient concentrations and dissolved oxygen are important water quality parameters that are related to watershed development that affect the availability of aquatic and terrestrial wildlife and habitat supported by the Bay.

Purpose and Authority: This project entails a multi-purpose/ multi-objective evaluation of the Western Lake Erie Basin (WLEB) and Watersheds by the U.S. Army Corps of Engineers (USACE) to 1) integrate existing projects, plans and studies; 2) assess program progress; and 3) plan future lake and watershed revitalization programs and projects from various federal, state, local and non-governmental organizations. The final product, a comprehensive Western Lake Erie Basin and Watershed Framework, will provide public agencies, watershed groups and other stakeholders with a tool to facilitate the restoration, protection and sustainable use of the water and related natural resources within the study area.

The WLEB study is authorized in Section 441 of the Water Resources Development Act (WRDA) of 1999. This authority directs the Assistant Secretary of the Army for Civil Works



Figure E-2. Commercial shipping traffic in Maumee Bay.

to conduct a study to develop measures to improve flood control, navigation, water quality, recreation, and fish and wildlife habitat in a comprehensive manner in the Western Lake Erie Basin.

Methodology: The preparation of this assessment consisted of 1) a comprehensive review of existing studies and technical reports to identify problems, opportunities and project needs; 2) hosting a workshop at a central location in the watershed where elected officials, agencies, and citizens were invited to share their comments and identify local problems, opportunities and needs; 3)

distribution of a project needs request form to all county, community, state, and local agencies and other nonprofit organizations by letter and also posting the request on the WLEB web site; 4) making direct contact with key agencies to request information on current projects and project needs; 5) distribution of draft materials to WLEB Partnership for review and comment; and 6) completion of both internal and external USACE Independent Technical Reviews (ITR).

Special Note: This assessment of Maumee Bay covers topics similar to those addressed in the other watershed assessments. It has some differences, however, given that it focuses exclusively on the open waters of Maumee Bay. Impacts from the contributing watershed are discussed when critically important and, in other instances, references are made to other assessments that address these issues. Further, there are text sections of this report and summary tables where data are missing, these sections depend on the results of reviews of the reports on individual watersheds.

Water Body Characteristics:

- **Physical System and Natural Resources:** Maumee Bay, for the purposes of this assessment, is defined as the portion of Lake Erie that is west of a line drawn between Woodtick Peninsula and Cedar Point, including Toledo Harbor. An area of influence on the Bay extends in an arc from the base of Woodtick Peninsula around the open lake placement sites, Turtle Island, and Toledo Harbor Light to the Northern side of the Ottawa Wildlife Refuge. The Bay is shallow, with depths typically less than 10 ft and an average depth of five ft. A 200 ft wide navigation channel extends from the Maumee River through the Bay and into Lake Erie. Maumee Bay is the terminus of the Maumee and Ottawa Rivers and several small streams. In total, it receives drainage from 4.2 million acres. Much of the drainage area is part of the Maumee River and Ottawa River watersheds.
- **Socio-economic Characteristics:** Maumee Bay supports a range of water resource-based recreational activity including sport fishing and boating. It also supports a commercial fishery and substantial commercial maritime activity given the Port of Toledo's status as a major domestic and international port in the Great Lakes- St. Lawrence Seaway System...

➤ **Cultural Attributes:** Cultural attributes of Maumee Bay reflect the maritime history of the region. The National Park Service lists the Toledo Harbor Light, Toledo Yacht Club and West Sister Island Light as significant cultural resources. In addition, numerous shipwrecks are present in Maumee Bay.

➤ **Institutional and Regulatory Setting:** The use and management of Maumee Bay is of interest to governmental entities from the local to international level. It lies physically within the boundaries of Ohio and Michigan, yet is affected by lake wide management and regulatory activities that have multi-state, federal and international dimensions. A multitude of regulatory, management, research and policy agencies are actively involved in Maumee Bay issues, as are multiple nongovernmental entities.

Resource Analysis - Issues and Opportunities:

➤ **Lake Levels, Water Supply and Sedimentation:** Water levels in Maumee Bay experience both short and long term fluctuations due to seiche and storm- related events; variations from seasonal hydrologic effects, and long term impacts associated with basin-wide precipitation trends. Among others, these changes can impact coastal wetlands, nearshore habitat, water supply intake structures, and commercial and recreational navigation activity.

➤ **Water Quality:** Maumee Bay is influenced by inflows from the Maumee, Ottawa and other smaller watersheds that drain into the bay. As such, many of the water quality issues are similar to those of these watersheds, including high levels of bacteria, nutrients, turbidity and sediment deposition. However, some water quality issues unique to the Bay include harmful algal blooms (Figure E-3), low dissolved oxygen and beach closings due to high levels of pathogens.

➤ **Natural Resource- based Recreation:** Recreational activities associated with Maumee Bay are diverse. Water based activities include recreational and sport fishing, swimming and boating. Activities enhanced by their proximity to the Bay include birding, hiking, biking, picnicking, wildlife viewing and golfing. These recreational opportunities are enhanced by numerous boat access points and parks along the Lake shore. Many of the recreational opportunities provided by the Bay are directly related to its water quality and fish and wildlife habitat.

➤ **Fish and Wildlife Habitat:** Maumee Bay features several habitat types. Offshore areas are home to numerous fish species, including several endangered and threatened species. The near shore area, including Toledo Harbor and the Maumee River provide spawning and/ or nursery



Figure E-3. *Lyngbya* covering Maumee Bay shoreline (Photo by T. Bridgeman).



habitat. Terrestrial wildlife along the shore is similar to that located in the lower Maumee River watershed.

➤ **Commercial and Recreational Navigation:** The Lower Maumee Basin is characterized by intensive and geographically concentrated commercial and recreational navigation activity, all of which has significant environmental and socio-economic implications for the current and future status of the basin. The Toledo- Lucas County Port Authority and associated facilities are predominant features in the watershed, comprising the eighth largest port on the Great Lakes system and the 53rd largest in the United States, based upon materials shipped and received. Recreational navigation occurs throughout the Lower Maumee Watershed. There are numerous public and private marinas, docks and access ramps along the Maumee River, which are used for boating, canoeing, fishing, hunting and other recreational uses. A navigation channel is maintained through Maumee Bay and is dredged frequently.

Findings and Potential Actions: Maumee Bay is home to intensive multiple use activity that supports a significant level of commercial shipping and recreational boating, commercial and recreational fishing, and water based recreation from shoreline parks. These activities provide substantial economic benefit to shoreline communities and businesses, with direct and indirect impacts reaching far beyond the Maumee Bay project area. Much of this economic activity is closely linked to the ecological condition of the Bay, including water quality, fish and wildlife habitat, and the health and population of the sport and commercial fishery.

MAUMEE BAY

SELECTED POTENTIAL ACTIONS SUMMARY

Section 3. Lake Levels, Water Supply, Sedimentation

- ☐ Continue to encourage watershed based BMPs to reduce costs associated with sedimentation.
- ☐ Monitor lake level changes on beach erosion and water supply intakes.

Section 4. Water Quality

- ☐ Continue to study the interaction between nutrients, algal blooms and zebra mussels.
- ☐ Complete watershed action plan to identify priority restoration projects within the watersheds that will reduce nutrients and sediments to the Maumee Bay.
- ☐ Secure funding to implement Long Term Control Plans in the watershed.

Section 5. Natural Resource-based Recreation

- ☐ Complete comprehensive recreation plan to identify gaps, priorities, funding needs and opportunities for multi-objective recreation projects for the Maumee Bay and near shore areas.
- ☐ Identify gaps in access for recreational users and identify plan to improve quantity of access points.
- ☐ Complete RMS demonstration project.

Section 6. Fish and Wildlife Habitat

- ☐ Assess status of riparian areas and remaining wetlands, and establish priorities for enhancement and restoration in the interest of conserving/ enhancing aquatic habitat and fish and wildlife resources.
- ☐ Fund conservation practices that enhance wildlife habitat in the bay.

Section 7. Commercial and Recreation Navigation

- ☐ Continue to maintain navigation channel for commercial shipping.
- ☐ Continue to fund and investigate watershed based controls of sedimentation to reduce dredging costs.
- ☐ Continue to fund and investigate dredged material disposal methods.

Nutrient and sediment loading from the Maumee River, as well as the prevalence of nonindigenous aquatic invasive species, are among the major threats to the health of the Bay, given their adverse impacts upon water quality, the fishery, habitat and natural resource- based recreational activities. Commercial navigation, which is dependent on dredged channels within



the Bay and Toledo Harbor, is adversely impacted by the sediment load from the Maumee River and the costs associated with channel maintenance.

A substantial level of research is underway or planned for Maumee Bay and Lake Erie, focusing on a range of water quality, fishery, habitat and resource user issues. Primary federal management and research agencies (e.g., U.S. EPA, USGS, USFWS, NOAA, and USACE) are involved, as well as state agencies, area universities and other nongovernmental entities. Data and information gained from research and management initiatives will be useful in determining primary causes of issues facing the Bay and prioritizing actions within the Bay and contributing watersheds. A total of \$22,240,000 of potential actions were identified during the completion of this assessment.

Plan Implementation: The strategy for implementing identified potential actions will depend upon potential sponsors (i.e., federal, state, regional, local, nonprofit, private). At the federal level and, specifically for those projects which the USACE decides to proceed with or further consider, the implementation strategy will depend upon whether the action falls within existing authorities or whether specific authority will be needed. In addition, project funding will depend upon Congressional appropriations either for existing authorities or for specifically mandated projects.



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1. INTRODUCTION

1.1 Significance of the Planning Process

The importance of water and related natural resources to the environmental quality and economic well being of the Western Lake Erie Basin (WLEB) and its residents has long been recognized. Federal recognition is found in Section 441 of the Water Resources Development Act (WRDA) of 1999, which called upon the Secretary of the Army to “conduct a study to develop measures to improve flood control, navigation, water quality, recreation, and fish and wildlife habitat in a comprehensive manner in the Western Lake Erie Basin, Ohio, Indiana, and Michigan, including watersheds of the Maumee and adjacent Ottawa and Portage Rivers”.

A Section 905(b) analysis (Reconnaissance Study) conducted by USACE in 2003 confirmed the federal interest in this initiative and facilitated an expanded focus leading to a Feasibility Study. That analysis also indicated that Representative Marcy Kaptur supported federal funding “to allow for comprehensive problem and opportunity identification throughout the entire watersheds specified in the original legislation.” Figure 1-1 depicts the WLEB in the context of the larger Great Lakes Basin.

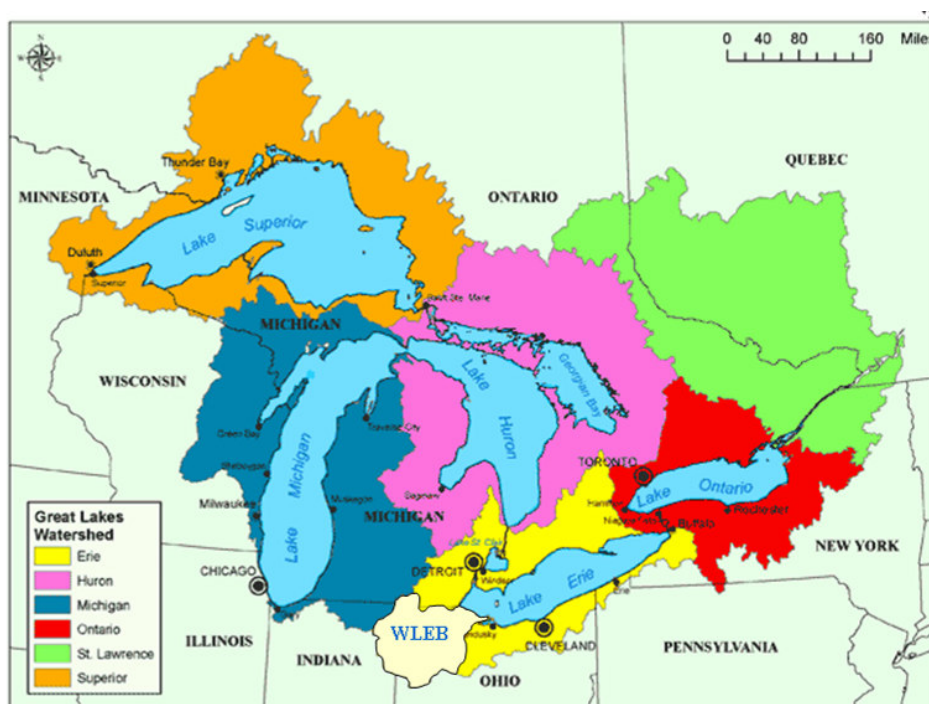


Figure 1-1. Location of Western Lake Erie Basin in the Great Lakes.

The planning process for the Western Lake Erie Basin is significant on several levels, as it:

- *Addresses a number of problems and opportunities critical to the future of the Basin;*

- *Reflects the federal interest in the use, protection and management of the Basin's water and related natural resources;*
- *Embraces a comprehensive, watershed- based approach to planning;*
- *Features a highly collaborative process involving an array of partners;*
- *Consolidates, analyzes and summarizes a wealth of data and information, presenting it in a well documented and referenced "reader friendly" manner;*
- *Reflects a bias toward action, with a focus on practical and pragmatic guidance for future actions by a range of partners;*
- *Makes a critically important contribution to ecosystem restoration planning and management initiatives at the Great Lakes Basin level; and*
- *Provides a template for potential application to other watersheds within (and beyond) the Great Lakes Basin.*

1.2 Plan Overview

1.2.1 Purpose: This project entails a multi-purpose/multi-objective evaluation of the Western Lake Erie Basin and Watersheds to 1) integrate existing projects, plans and studies; 2) assess program progress; and 3) incorporate future lake and watershed revitalization programs and projects into a comprehensive Western Lake Erie Basin State of the Basin report. Toward that end, USACE is completing existing conditions assessments for each of ten areas included in the WLEB project study area (i.e., Blanchard, Ottawa, Lower Maumee, Upper Maumee, Tiffin, St. Joseph, St. Mary's, Auglaize and Portage River watersheds, and the Maumee River Western Basin.) These watersheds are depicted in Figure 1-2. Individual watershed assessments will be rolled up into a comprehensive Western Lake Erie Basin State of the Basin report to be submitted to the Congress.



Figure 1-2. Western Lake Erie Basin major watersheds.

1.2.2 Authority: The WLEB study is authorized under Section 441 of WRDA 1999. This authority directs the Assistant Secretary of the Army for Civil Works to conduct a study to develop measures to improve flood control, navigation, water quality, recreation, and fish and wildlife habitat in a comprehensive manner in the WLEB. The basin consists of the Maumee, Ottawa, and Portage River watersheds in the states of Ohio, Indiana and Michigan. In carrying out the study, the Secretary is directed to cooperate with (and consider the relevant programs of) interested federal, state and local agencies, as well as non-governmental organizations.

USACE completed a Section 905(b) Reconnaissance Analysis in October 2001. USACE Headquarters subsequently approved (on December 9, 2003) an Expanded Reconnaissance Analysis as a basis for preparation of a Project Management Plan and Feasibility Cost-Sharing Agreement for detailed watershed studies. Based on that analysis, a Feasibility Cost Share Agreement (FCSA) was signed with the city of Toledo in May 2006. Additional agreements will be developed, as needed, for individual projects that may result from plan implementation.

1.2.3 Desired Outcome: The planning effort responds to a directive in Section 441 of WRDA 1999 to “conduct a study to develop measures to improve flood control, navigation, water quality, recreation, and fish and wildlife habitat in a comprehensive manner....” This is to be accomplished through a partnership- based initiative entailing:

- A comprehensive review and analysis of existing studies, plans, reports and associated data and information;
- The identification of problems, opportunities and unmet needs as voiced by policy makers, opinion leaders and other stakeholders; and
- The generation of findings and potential actions that will provide a “blueprint” to guide various public agency and non-governmental partners in the selection, prioritization and implementation of specific actions to address problems and unmet needs.

Collectively, this goal (and its associated planning objectives) will lead to a desired outcome for the Basin and its residents: *the restoration, protection and sustainable use of the water and related natural resources of the Western Lake Erie Basin.*

1.3 Methodology

1.3.1 Planning Team: Roles and Responsibilities: Led by the USACE- Buffalo District, the Planning Team is comprised of the members of the WLEB Partnership, a collaborative multi-governmental (i.e., federal, state, local) initiative “dedicated to enhancing multi-purpose

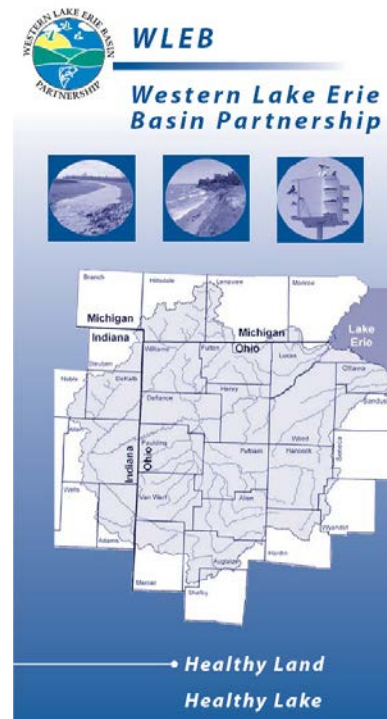


Figure 1-3. WLEB Partnership.

projects that improve land and water resource management in the basin and promote a healthy, productive watershed.”

The Partnership organizational structure includes a Leadership Committee supported by coordination teams addressing operations, project management, funding, research and data, and public outreach (Appendix B-1 and B-2). The Partnership is guided by principles that include collaboration and consensus building; capacity- building at the local level; a results-oriented approach; and a transparent, open process.

1.3.2 Plan

Constituents: WLEB

Plan constituents are both participants in- and beneficiaries of- the planning process. The

Project Management Plan for the Reconnaissance level study notes that “...the Secretary [of the Army] was directed to cooperate with interested Federal, State, and local agencies and non-governmental organizations and consider all related programs of the agencies.” Findings and potential actions generated by the planning process constitute a “capital improvements program” for the Basin that will involve all levels of government (and non-governmental stakeholders) in prioritization and implementation.

The U.S. Congress is a key constituent of the planning process, as indicated by its authorization in WRDA 1999. Constituents also include federal agencies (e.g., U.S. Army Corps of Engineers, Natural Resources Conservation Service, U.S. Environmental Protection Agency); state agencies (e.g., Departments of Natural Resources, Environmental Protection, Transportation); regional agencies and associations (e.g., Toledo Metropolitan Area Council of Governments, Western Lake Erie Basin Partnership); local agencies (e.g., cities and townships); and an array of citizen, business/ industry, and user groups with an interest in the restoration, protection and sustainable use of the resource.

1.3.3 Planning Principles, Assumptions and Constraints: The planning process was guided by a series of principles embraced by the Project Team and reflected in all aspects of its Work Plan. Team members agreed that project design and conduct would feature:

WLEB PARTNERS

*U.S. Army Corp of Engineers
U.S. Department of Agriculture, Natural Resources Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Geological Survey Ohio Water Science Center
Governor of Indiana
Governor of Michigan
Governor of Ohio
Indiana State Technical Committee
Michigan State Technical Committee
Ohio Department of Natural Resources, Div. of Soil and Water Conservation
National Association of Conservation Districts
Maumee River Basin Partnership of Local Governments*

Partnership Mission Statement

The Western Lake Erie Basin Partnership is a tri-state partnership dedicated to enhancing multi-purpose projects that improve land and water resource management in the basin and promote a healthy, productive watershed.

- An **open and inclusive process** actively soliciting stakeholder engagement and substantive contributions to the planning effort;
- A **partnership- oriented process** driven by the collective input of all public and non-governmental entities with a role, responsibility or interest in the future of the Western Lake Erie Basin;
- A **watershed- based approach** favoring the use of hydrologic rather than geo-political boundaries in characterizing the resource and planning for its restoration, protection and sustainable use;
- A **multi-objective and multi-disciplinary process** recognizing the environmental, economic, social and cultural dimensions of resource use and stewardship;
- A **thorough examination and characterization of all relevant existing plans, studies, reports, data bases and other materials** contributing to an understanding of Basin conditions, issues, problems, unmet needs and prospective solutions;
- A **commitment to seek consistency with the range of existing plans and strategies** offering a vision for the Basin and recommendations to achieve it; and
- A **commitment to a concise, practical and pragmatic document** providing the reader with a “blueprint” of potential actions, their rationale, and their impact.

The Project Team designed its approach around a series of assumptions. USACE Principles and Guidelines, as well as applicable regulations and federal laws, have guided the planning process, as has authorizing language in Section 441 of WRDA 1999. Finally, based upon guidance received from Corps project officers, it was assumed that the Project Team would exercise some discretion (subject to final approval) in 1) selecting a preferred format and content for the individual watershed assessments; and 2) identifying “potential actions” relevant to all agencies and organizations within the Basin, including (but not limited to) USACE..



Figure 1-4. Satellite view of sediment plume entering Maumee Bay.

Constraints associated with the project relate primarily to focus, scope, budget, timeframe and implementation authority. The Project Team worked within the parameters of the WRDA language, which limited the primary focus to flood control, water quality, recreation, fish and wildlife habitat, and commercial and recreational navigation. Funding availability and completion deadlines also influenced project methodology and depth of analysis, placing some limitations on data/ information gathering from various sources and, in particular, from stakeholder engagement.

Finally, Project Team responsibilities were limited to the generation of “potential actions” and did not include detailed attention to plan implementation.

1.3.4 Communications and Coordination Strategy: The Project Team adopted a policy of “continuous communications” involving USACE, the project contractor (URS Corporation), the WLEB Partnership, and the larger community of stakeholders. Regularly scheduled coordination meetings between USACE and URS (including liaison with the WLEB Partnership) ensured a clear understanding of expectations, responsibilities and timelines. Stakeholder meetings at the onset of the planning process, complemented by interviews and other communications throughout the process, provided interested parties with multiple “access points” to contribute to/ comment on interim products.

1.3.5 Steps in the Planning Process: Watershed assessments are multi-objective initiatives that feature a flexible approach to plan formulation and evaluation. The outcome is a basin/watershed management plan that identifies potential actions (and sponsors) to achieve established objectives. Steps associated with this watershed assessment process include:

- Define the study area based on hydrologic units.
- Establish a watershed group (partnership) to participate in the planning process.
- Establish a framework for federal, state, local, and tribal involvement in the plan process.
- Investigate all problems, needs and opportunities consistent with authorizing language.
- Develop a vision for the watershed and associated goals and objectives.
- Develop a scope of work for accomplishing all study tasks.
- Research historic and current conditions and uses of the watershed.
- Identify potential future changes in the watershed and associated future conditions.
- Qualitatively assess cumulative effects of various activities in the watershed.
- Evaluate alternative resource uses and environmental, economic and social impacts.
- Prioritize water and land-related resource problems and opportunities.
- Identify and evaluate conflicting uses and monetary/ non-monetary trade-offs.
- Develop measures to assess progress in implementing recommended future activities.
- Assess project costs, benefits, and environmental impacts of recommended activities.
- Identify and prioritize potential actions in each watershed.
- Document how potential actions will achieve restoration, protection and sustainable use.
- Determine the optimal schedule (and sponsor) for implementing potential actions.
- Prepare a comprehensive watershed plan.
- Pursue USACE- identified projects under normal budget procedures.

These steps provided general guidance in the preparation of the Maumee Bay Watershed Assessment, consistent with the various principles, assumptions and constraints identified above.

1.3.6 Reference Materials: An extensive library was established to support project activities and provide cited references for planning documents (Section 11 References Cited).

1.3.7 Plan Implementation Strategy: The watershed assessments will provide guidance to an array of public and non-governmental entities with a role and responsibility for the restoration, protection and sustainable use of the water and related natural resources of the WLEB. Specific approaches to plan implementation will be a function of requirements and procedures associated with potential sponsors. As noted, they will likely range from federal agencies and state/ local governments to private sector and other non-governmental entities.

The plan implementation strategy for federal projects will be dictated by the nature of the potential action, and whether that action can be implemented under existing authority or will require authorization by the Congress. Plan implementation for other projects will be accomplished via partnerships among local, state and federal entities and/or by specific sponsors. Funding sources for implementation will vary, but could include a broad range of traditional (e.g., federal, state and local government funding, foundations) and non-traditional sources (e.g., conservancy districts, utilities, assessments, mitigation banks, in-lieu fees.).

1.4. Report Overview and Organization

This report is organized into multiple primary chapters that respond to authorizing language in Section 441 of WRDA 1999. A *waterbody general setting* is offered in Chapter Two, and includes the physical system and natural resources; socio-economic characteristics; cultural

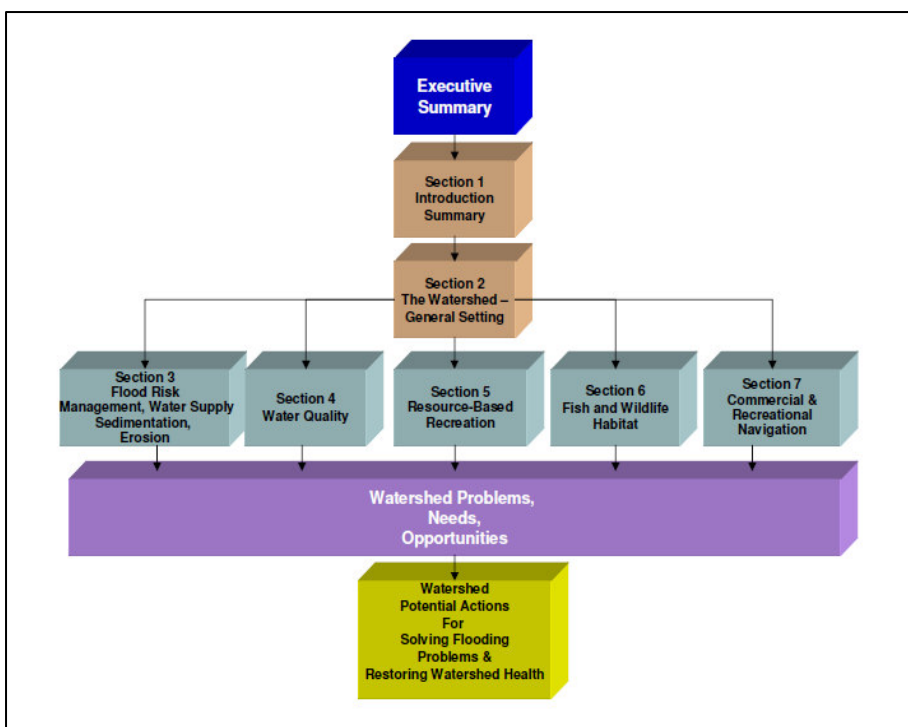


Figure 1-5. Report organization.

characteristics; the institutional and regulatory setting; and trends/ issues and their implications for protection and management. Chapter Three focuses principally on *water quantity issues* (i.e., flood risk management, water supply, sedimentation, bank erosion) while Chapter Four addresses *water quality*. *Natural resource-based recreation* is the focus of Chapter Five, and focuses on parks (local and

regional), hunting preserves, and other recreation activities (e.g., hiking, biking, canoeing,



boating, fishing, hunting.) Chapter Six focuses on *fish and wildlife habitat*, documenting problems, needs and opportunities associated with forested, riparian and wetland habitat resources. *Commercial and recreational navigation* is the topic of Chapter Seven, documenting existing facilities, uses and unmet needs that can be addressed by a series of potential actions. Based on the findings and potential actions discussed previously, Chapter Eight provides a framework to establish priorities with the participation of stakeholders. Also provided is a discussion of Future Watershed Conditions. *Plan integration* is the focus of Chapter Nine, which discusses the relationship of individual watershed reports to the larger basin-wide integrated report that will be presented to the Congress. Chapter Ten addresses *plan implementation* in general terms, and how project findings will be implemented and by whom.

2. MAUMEE BAY- GENERAL SETTING

2.1 Introduction

Maumee Bay is one of 10 areas included in the Western Lake Erie Basin Project Area (Figure 2-1). It is located within the States of Ohio and Michigan and comprises approximately 5% of Lake Erie's surface area (Figure 2-2). Maumee Bay receives flow from the Maumee River and its tributaries, which drain approximately 4.2 million acres (~6,500 sq. miles) of both urban and agricultural land. Toledo Harbor is an important domestic and international port along the Great Lakes and St. Lawrence Seaway System. Lake Erie, Maumee Bay, and the Maumee and Ottawa Rivers provide diverse fish and wildlife resources. The natural resources of the harbor and urban areas have been degraded in the past due in part to urban development and related point and non-point discharge contaminants.

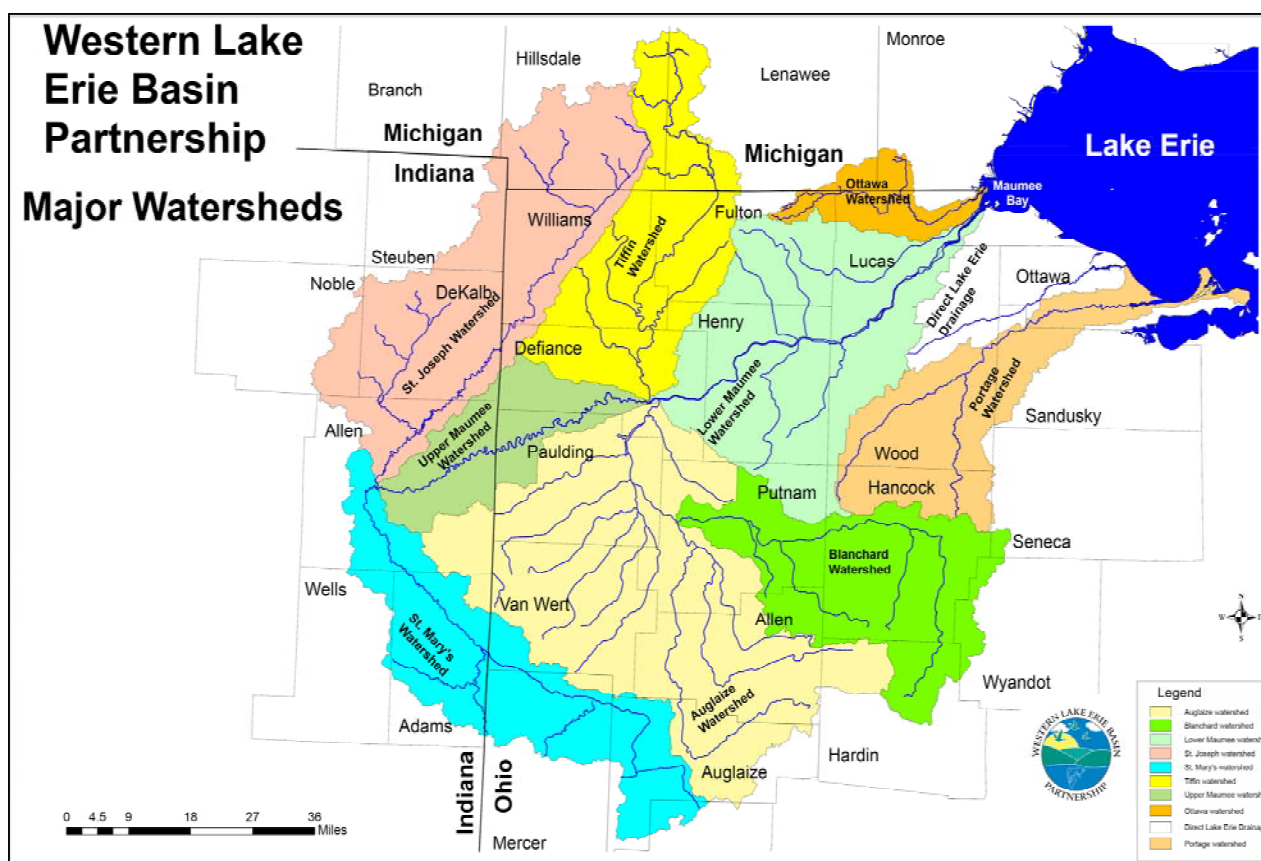


Figure 2-1. Western Lake Erie Basin project area.

2.2 Physical System and Natural Resources

2.2.1 Location and Geography: Maumee Bay is a shallow, semicircular embayment located in the extreme southwestern corner of Lake Erie and encompasses the water area separated from the lake by two spits, Woodtick Peninsula and Cedar Point. The bay comprises about five percent of the surface area of Lake Erie's western basin (~21 square miles), and lies between 41°41'N and 41°45'N latitude and 83°20'W and 83°29'W longitude, within the States of Michigan and Ohio. Major river inflow into the Bay comes from the Maumee River. North of the Maumee River, the Ottawa River and several small creeks enter the Bay. East of the Maumee River, two small creeks and several drainage ditches enter the Bay.

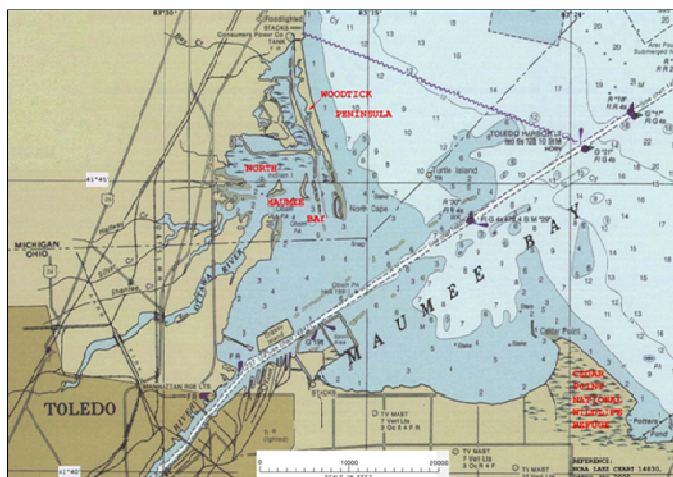


Figure 2-2. General location of Maumee Bay in Lake Erie (NOAA, 2008).

With the exception of the Toledo Harbor navigation channel, Maumee Bay is very shallow, with bottom depths generally at less than 10 feet below Low Water Datum (LWD) and an average depth of about five feet below LWD (Benson 1975). Relief within the Bay is low, except near the navigation channel where linear shoals are present, formed by sidecast dredging decades ago. The proportion of deposits on the bottom of Maumee Bay that are predominantly sand total 47%, almost equal to the number of samples (51%) that are predominantly mud (silt and clay) (McLaren 2003). Figure 2-3 presents a location map of the Bay.

2.2.2 Climate: Maumee Bay has a humid continental climate characterized by four distinct seasons and large swings in temperature and precipitation. Precipitation, as measured at Toledo, Ohio, averages around 31.8 inches per year (131 year average) with the maximum average amount usually occurring in June (3.49") and the minimum falling in February (1.93") (NOAA, 2000). Snowfall is generally light, distributed from November to March and averaging about 37 inches.

Maumee River Watershed HUC-8's which drain Maumee Bay:

<u>HUC11</u>	<u>Water Assessment Unit Description</u>
04100001	- Ottawa River Watershed
04100009	- Lower Maumee River Watershed
04100006	- Tiffin River Watershed
04100007	- Auglaize River Watershed
04100008	- Blanchard River Watershed
04100005	- Upper Maumee River Watershed
04100003	- St. Joseph River Watershed

The presence of Maumee Bay has a moderating affect on the temperature experienced on the adjacent land. Temperature extremes are seldom recorded as, on the average, only fifteen days

a year experience temperatures of 90 degrees Fahrenheit and only eight days experience temperatures lower than zero degrees Fahrenheit. Humidity is rather high and excessive cloudiness results in 30% possible sunshine in winter. December and January are the most overcast months with sometimes as little as 16% “possible” hours of sunshine. Prevailing winds are from the west, southwest and south. Severe windstorms occur infrequently but, on average, there are 23 days annually with sustained wind speeds of 32 mph or more (NOAA 2001).

The climate of the region influences Maumee Bay, which freezes over most winters and has water temperature around 0.5° Centigrade (33° Fahrenheit) from approximately mid-December to mid-March. Lake water in this basin generally cools quicker in the fall and warms-up faster in the spring than does the rest of Lake Erie.

2.2.3 Air Quality: The U.S. Environmental Protection Agency (USEPA) has developed maximum allowable concentrations of pollutant discharges into the air, referred to as National Ambient Air Quality Standards. Monitoring parameters include Ozone, PM 2.5 Particulates, PM 10 Particulates, SO₂, Carbon Monoxide, Lead and Nitrogen Dioxide. Each state has developed ambient air quality pollution control standards that may either be the same, or more restrictive than the USEPA standards (in this case the same). Essentially, air quality conditions in the Toledo Harbor vicinity do not contravene established air quality standards (USEPA web site).

2.2.4 Bathymetry: The bottom of Maumee Bay is a broad and extremely shallow shelf sloping gently to the northeast (Benson 1975). The once sinuous Maumee River channel through the bay has been straightened and deepened (28 foot depth) for navigation, splitting the Bay in half. A series of linear islands and shoals formed by earlier sidecasting of dredged material represent the only other major relief within the bay, as well as several small islands in North Maumee Bay. Lakeward of the Bay, and about five miles from the mouth of the Maumee River, lies Turtle Island. Named after Little Turtle, a leader of the Miami tribe, the island lies at the end of a sand and gravel shoal that extends northwest from the tip of Cedar Point. Maumee Bay was surveyed and drawn under the direction of Captain George G. Meade in 1857. As depicted in Figure 2-4, the Bay was generally shallower than 12-feet. This area was resurveyed under the *Survey of the Northern and Northwestern Lakes* in 1874-1879. A portion of the Maumee Bay area from that hydrographic chart is presented in Figure 2-5. As with the 1857 chart, the offshore contours are highlighted to make them more visible.

2.2.5 Lake Levels and Regional Flooding:

The natural hydrologic cycle provides the driving force behind changes to Lake Erie levels. The lake level is typically highest during early summer or spring and lowest during the winter. Long-term changes to lake levels are dependent on the cumulative effects of deviations from average climate conditions.

Above normal lake levels were present from the mid 1960's to the late 1980's when a record high was recorded in 1986. Lake levels returned to more average levels for a decade and then, due to below normal precipitation and greater than average evaporation, the lakes levels fell below normal in spring of 1999.

The lake generally remained below average until 2004, fluctuations occurred in 2004, 2005 and 2006, generally following precipitation patterns. Climate change predictions suggest that future lake levels will continue to fluctuate, but lower levels may become more common (Toledo Blade, 2008). Flood Insurance Studies (FIS) investigate the existence and severity of flood hazards under the authority of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. These studies have been completed for Monroe County, Michigan and Lucas County, Ohio. As part of these investigations, Flood Insurance Rate Maps (FIRMs) were developed (FEMA, 2007). Of the streams entering the bay, the

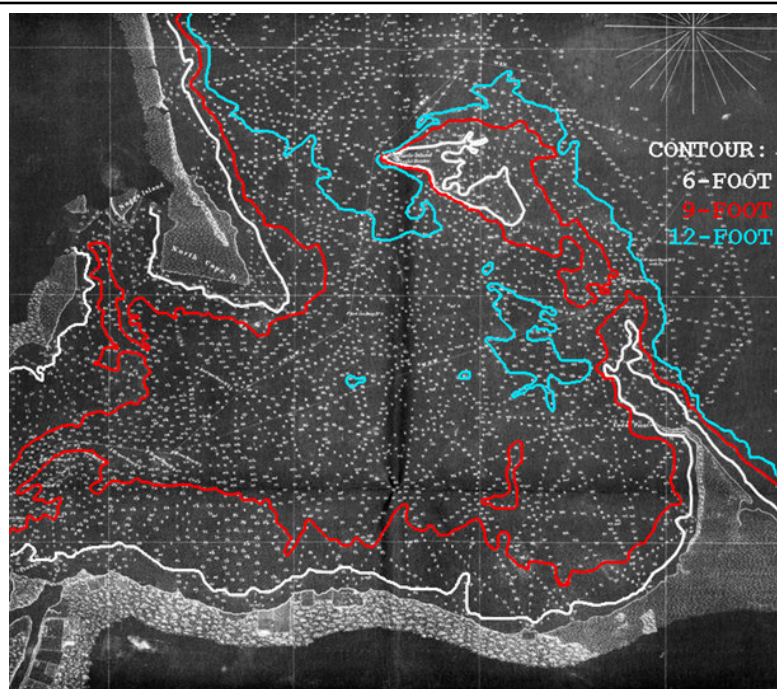


Figure 2-3. Captain George Meade's 1857 Map of Maumee Bay with annotations for the 6, 9 and 12 foot contours.

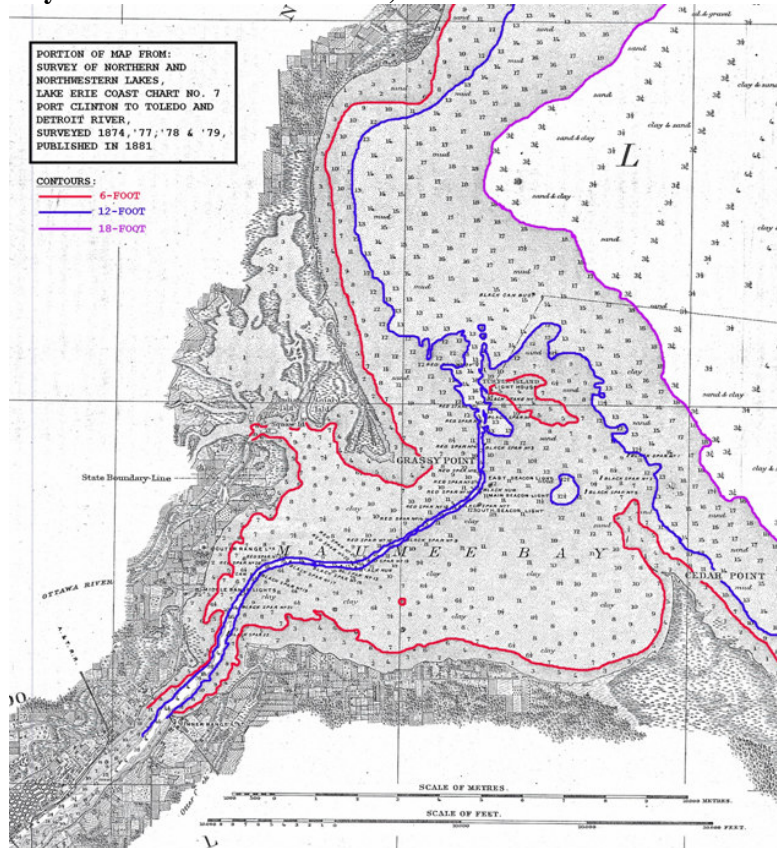


Figure 2-4. Historical Maumee Bay hydrographic data from the Survey of the Northern and Northwestern Lakes.

Maumee River has the largest record of flooding. Major floods have been recorded as early as 1832, with the largest known flood to have occurred on 26 March 1913 with an estimate discharge of 180,000 cfs and recurrence frequency greater than 500-years (FEMA 2000). Significant flooding was also observed in 1913 along the Ottawa River. Severe flooding along the bayshore occurred in March 1973, April 1974, and March 1975, with the worst flood of recent record occurring in November 1972.

2.2.6 Water Resources: Maumee Bay provides water for multiple purposes including industrial processes, cooling water, recreation, aquatic habitat, commercial shipping and commercial fishing. Water quality and sediment issues are primary concerns within Maumee Bay and impact the range of water resource-based uses and activities.

As the Maumee River flows toward Lake Erie through low, flat agricultural land, its waters degrade in quality as considerable amounts of sediment and other pollutants are collected. The Toledo metropolitan area contributes additional pollutants from urban runoff and point source discharges. Low levels of dissolved oxygen, nuisance algae, high levels of coliform bacteria, nutrients, turbidity, suspended solids and conductivity, including discharge of heavy metals and pesticides, also add to water quality degradation. Most turbidity and pollutant loading occurs in the spring season during heavy runoff events. The waters of Maumee Bay are more turbid than waters in the open-lake, but less turbid than waters at the mouth of the Maumee River. The river's water quality is poorest, followed by the Maumee Bay waters, which improve lake-ward.

Nutrients and sediment loads have an impact on the lentic environment of Maumee Bay. Algal blooms in the 1960s led to approximately a 60% reduction in phosphorus loading to Lake Erie. This reduction resulted in an 89% decline in blue-green algae between 1970 and 1985 (Makarawicz and Bertman, 1991 in USEPA, 2008). During the mid 1980s, zebra mussels colonized Lake Erie resulting in improved water clarity and changes in algal production. In the late 1990s large late summer algal blooms appeared in Western Lake Erie and seem to be increasing in frequency. Several studies by the NOAA's Great Lakes Environmental Research Laboratory suggest that the algal blooms are linked to nutrient loading, as well as nutrient releases/ selective feeding by zebra mussels. Low dissolved oxygen and toxics from the algal blooms can negatively impact aquatic life in Maumee Bay.

The Buffalo District of the U.S. Army Corps of Engineers (USACE) has done extensive sediment and associated water quality testing and analysis associated with the harbor dredging maintenance program. Based on sediment data from 2005 and 2006, the material in the Bay consists primarily of silts and clays. Gradual improvement in river and lake approach channel sediments has been observed over recent decades through assessments consistent with joint USEPA/USACE protocols for the testing and evaluation of Great Lakes dredged material (USEPA-USACE, 1998).

2.2.7 Aquatic Ecology: Maumee Bay contains a diverse macroinvertebrate community that appears to be dominated by aquatic earthworms (oligochaetes), dipteran (fly) larvae and midges (chironomids). Science Applications International Corporation (SAIC, 1988) collected and identified six groups of macroinvertebrate organisms at 15 sampling stations in Maumee Bay as a portion of a Maumee Bay Bottom Characterization Study. Tubificids (oligochaetes)

and ostracods appeared to co-dominate the benthic faunal community. Nematodes (roundworms) and chironomids, which were most abundant in shallow sampling stations, were the next most abundant taxa sampled. Psidiidae and Naididae (aquatic worms) were also collected. In addition, T.P. Associates (1987) collected eight benthic macroinvertebrate samples in Maumee Bay as part of an open-lake disposal site survey. This area is currently used as the open-lake placement site for dredged material. The benthic survey showed a predominance of chironomids and oligochaetes in the benthic community. *Chironomus* spp. and *Procladius* spp. were the chironomids sampled at the greatest relative abundance. The tubificid "*Limnodrilus hoffmeisteri*" appeared to dominate the oligochaete fauna. The mollusk (clam) group Sphariidae was also collected in this survey.

Aquatic areas in the WLEB are utilized as habitat by a variety of plankton. Such organisms may consist of possibly floating or weakly swimming plant and animal life in the water column, that are often microscopic in size which contribute to the food chain in the Lake's ecosystem. Herdendorf's (1987) biological report on western Lake Erie identifies some of the common plankton and epiphytes (organisms that live on the surface of plants) such as algae, protozoans and zooplankton known to have occurred in this locale. The following is a brief summary of algae, protozoan/zooplankton phyla, including the number of families and species of these organisms represented in each phylum, that were mentioned in the report: Cyanophyta (blue-green algae) represented by 22 families and 124 species; Pyrrophyta (fire algae) represented by 6 families and 10 species; Cryptophyta (cryptomonads) represented by 1 family and 4 species; Rhodophyta (red algae) represented by 3 families and 3 species; Euglenophyta (Euglenoids) represented by 3 families and 37 species; Protozoa represented by 29 families and 26 species; Coelenterata represented by 1 family and 1 species; Rotifera represented by 28 families and 78 species, and finally, the phylum Arthropoda represented by 14 families and 33 species.

The littoral zone vicinity of Maumee Bay contains a number of submerged aquatic macrophyte beds. The final U.S. Fish and Wildlife Service's (USFWS) Coordination Act Report of 1987 states that during an aerial survey of the Bay and lower Maumee River conducted by their service, a number of submergent aquatic plant beds were observed. The USFWS report indicated "seven areas containing small to moderate size beds along the Maumee Bay shoreline east of the Bayshore Power Plant discharge, a relatively large bed at the mouth of, and just upstream of Otter Creek, scattered beds northeast of Cullen Park peninsula, large beds in the Cullen Park embayment and smaller beds in the embayment just upstream of the Harrison Marina were seen. The USFWS reported also mentioned that an Ohio Environmental Protection Agency representative observed aquatic beds in a large embayment on the north side of the Maumee River just upstream of the railroad bridge and along the northwest side of Grassy Island. Although aquatic beds are not unique to the bay locale, they are a part of a habitat type that is relatively scarce in the area. Herdendorf (1987) indicated that the open waters of the lake are primarily limited to submergent macrophytes such as curly pondweed, wild celery, sago pond-weed, water milfoil and water stargrass, whereas in bay areas of the lake, the main species of aquatic submergents are Richardson's pondweed, waterweed and coontail.

2.2.8 Forests, Wetlands and Floodplains: Wetlands are now generally considered to be one of the most valuable, and yet fragile, natural components of a watershed's health. In the past, wetlands were considered wastelands and for many years were filled or drained for agriculture and development. Before the 1970's, destruction of wetlands were common activities and even encouraged by government policies (Mitsch and Gosselink, 1993). Today, however, wetlands are predominantly viewed as highly productive environments that are crucial for the overall health of a watershed and its wildlife.

Coastal wetlands provide numerous functions that, depending on type and location may include food chain support, spawning, rearing, and nesting sites for aquatic or terrestrial species, nutrient cycling, shoreline/erosion control, ground water discharge/recharge, water purification and aesthetics. Increasingly, wetlands are also valued for recreation and education as they are educationally rich environments due to their ecological diversity (Smardon, 1979).

The coastal zone of Maumee Bay and Lower Maumee River shoreline contain a number of lacustrine and palustrine wetland types. Emergent wetlands are present in the general vicinity of Cedar Point (Cedar Point National Wildlife Refuge) and Woodtick Peninsula and, to some degree, occur incidentally/ periodically within Confined Disposal Facilities (CDFs.) USFWS Wetland Inventory Maps show about 14 classification types for wetlands in the general vicinity of the Bay and lower portion of the River. Herdendorf (1987) mentions that the main plant species growing in the Maumee Bay marshes (e.g., narrow broad-leaved cattail, jewelweed, blue joint grass, swamp milkweed, swamp rose mallow, soft-stem bulrush, three-square bulrush) dominate the transition zone between the cattail and open water of the Bay.

2.2.9 Fisheries and Wildlife Habitat: Both Maumee Bay and the Maumee River provide spawning and/or nursery habitat for a number of fish species. Maumee Bay appears to be a major spawning and/or nursery area for forage fish, particularly gizzard shad. Gizzard shad are the most important forage species for walleye in the eastern basin of Lake Erie (USFWS, 1987). A number of fish species in Maumee Bay have sport and/or commercial value including walleye, yellow perch, white bass, freshwater drum, channel catfish and white perch. Wildlife within or around Maumee Bay (i.e., the Maumee River Watershed) includes species adapted to farmland, woodland and wetland habitat land uses. There are also a variety of reptiles and amphibians and snakes. Some natural emergent vegetation and wildlife has established itself on idle portions of harbor CDFs.

Waterfowl are an important resource in the WLEB. Herdendorf (1987) mentioned that large numbers of waterfowl are attracted to coastal marshes along Lake Erie during migration periods. Spring season migrations start around late February and last into May; fall season migration peaks in the months of September and October. The WLEB is also a major waterfowl migration and wintering area, and its coastal marshes provide significant nesting and migration habitat. Many of the waterfowl in the area are diving ducks (e.g., scaup, goldeneye, merganser, ruddy ducks). Dabbling ducks such as mallards, black ducks, widgeon, gadwall and teal also use this area, but in more limited numbers. Maumee Bay provides a relatively shallow littoral zone feeding area for waterfowl. Resting areas are available in the Bay in the lee of small islands, such as in the vicinity of Island 18 (Grassy Island) and along the harbor CDFs. Even shallower water zones in the Bay and along CDFs are not only attractive to diving



ducks and dabbling ducks, but also to fish eating wading birds (i.e. Herons and Egrets) as feeding areas.

The shoreline areas of Maumee Bay feature extensive use by gulls (mainly herring and ring-billed), great blue herons and black-crowned night herons, great egrets, red-winged blackbirds, and ducks (USFWS). CDFs and islands also provide resting, feeding and nesting habitat for various aquatic bird and songbird species, including diving and dabbling ducks, gulls, terns and sandpipers.

USFWS has also recognized the Woodtick Peninsula and Cedar Point Wildlife Refuge as attractive funneling sites for large populations of migrating birds, due to their geographical location and unique physical and vegetation characteristics. The Woodtick Peninsula is a passerine bird and hawk migration site and important to shorebird migrations. The Cedar Point National Wildlife Refuge has an important wetland complex that provides food and cover for migrating aquatic birds (i.e. waterfowl, shorebirds), as well as habitat for passerines (USACE, 2002). In addition, USFWS notes that the American bald eagle is known to nest at the mouth of the Maumee River and at the nearby Ottawa National Wildlife Refuge, suggesting that it may utilize the shoreline and littoral zone of Maumee Bay as a feeding area. Although the bald eagle was removed from the endangered species list in August 2007, the species is still provided protection under the Bald and Golden Eagle Protection Act.

At the federal level, Maumee Bay is located within the range of the following threatened (T) and endangered (E) species: Indiana Bat (*Myotis sodalis*) (E), Karner blue butterfly (*Lycaeides melissa samuelis*) (E), piping plover (*Charadrius melodus*) (E), eastern prairie fringed orchid (*Plantanthera leucophaea*) (T), rayed bean mussel (*Villosa fabalis*) (C), and eastern massasauga rattlesnake (*Sistrurus catenatus*) (C). In addition, there is a list of federal species of concern in Ohio which includes mammals, birds, reptiles/amphibians, fish, invertebrates and plants.

At the state level, the Ohio Department of Natural Resources (ODNR) Division of Natural Areas and Preserves has identified the following records within the Maumee Bay area from their Natural Heritage Database (ODNR email dated 9/27/07): *Percina copelandi* (x4) – Channel darter, threatened; *Haliaeetus leucocephalus* – Bald eagle, state endangered; *Sterna hirundo* – Common tern, endangered.

2.3 Socio-economic Characteristics

2.3.2 Land Use: North Maumee Bay is located in Michigan and is outlined by the mainland to the north and west and Woodtick Peninsula (a natural area) to the east and north. The mainland and adjacent area includes a mixed development and the Erie State Game Area.

The Ottawa River area is located at the northwestern part of the Bay and Point Place. The Ottawa River flows northeastward through northwest Ohio where it empties into North Maumee Bay. The Ottawa River Watershed encompasses 178 square miles (133 square miles in Ohio, 45 square miles in Michigan) and flows through Fulton and Lucas Counties in Ohio



and Lenawee and Monroe Counties in Michigan. Halfway Creek and Hooper Run also flow into the area just north of the Ottawa River. The waters are very shallow in these areas.

Point Place is a mixed use development peninsula located between the mouth of the Ottawa River and Maumee Bay to the east. Channels for Lake Erie access are located at the northern tip of Point Place. Cullen Park and Detwiler and Bayview Retirees Golf Course(s) are located south of Point Place and at the north bank mouth of the Maumee River. Grassy Island, a USACE CDF, is located near the mouth of the Maumee River and north of the commercial navigation channel.

Most dock and railhead facilities are located at the mouth of the Maumee River along the south bank. Toledo Edison, Lucas County/Toledo Port Authority, and USACE CDFs are also located in this vicinity. Harbor View, a small village, is also located in this vicinity.

Mixed use developments exist along Bayshore Road (Immergrun) between Harbor View and South Shore Park. Eagles Landing Golf Course is located south of Bayshore Road in this reach. The southern shoreline of Maumee Bay east of South Shore Park is dominated by Maumee Bay State Park and, to the east, by Cedar Point (including Niles Beach, Maumee Bay State Park Golf Course, Mallard Club State Wildlife Area, and Cedar Point National Wildlife Refuge).

Land along the southern shore of Maumee Bay near the river mouth provides for various commercial and recreational uses. Diked disposal areas, Toledo Edison Co., Lakefront Dock and Railroad Co., C&O Railway Co., and Toledo Harbor-Lucas County Port Authority properties are located in this area. Land use is less commercialized opposite this side of the river mouth. The U.S. Coast Guard (USCG) and USACE properties are situated at the mouth and, further north on the bay, are Bay View Yacht Club and residential properties. Acreage along the lower Maumee River is extensively developed for commercial use. Manhattan Sewage Disposal Plant, Toledo Edison Co., Sinclair Refining Co., as well as numerous oil tank and properties are situated along this area of the river (USACE, 2002).

The Lower Maumee River is included in a Great Lakes Area of Concern (AOC) designated by the International Joint Commission. Identified Beneficial Use Impairments (BUIs) in 2005 included restriction on fish and wildlife consumption, degradation of fish and wildlife populations, fish tumors and other deformities, degradation of benthos, restriction on dredging activities, beach closings, degradation of aesthetics, and loss of fish and wildlife habitat (TMACOG, 2008). The BUIs are generally caused by both historic and present watershed activities that have led to habitat modification and contaminant problems. The Ohio Environmental Protection Agency (OEPA) and the Toledo Metropolitan Area Council of Governments (TMACOG) have developed and are pursuing a Remedial Action Plan to address these impairments. A number of other watershed best management studies/plans are also being pursued.

2.3.3 Business and Industry: Maumee Bay supports a diverse business and industrial community. Activities focused on the Bay and its resources include marinas, charter fishing, commercial fishing, power plants, harbor facilities and tourism.

Ohio Sea Grant Surveyed Ohio's Lake Erie charter fishing industry to gather information about the economic impact of the industry. They found that licensed fishing captains grew from 46 in 1975 to 1,211 in 1989. While most of the charter fishing captains did not make fishing their primary occupation, they did invest a considerable amount in their equipment. In 1990 an average charter fishing boat was valued at approximately \$60,000 and took an average of 37.5 paid trips each year. In 1990 this economic activity was estimated as \$9.2 million (Ohio Sea Grant Report FS-055). Ohio Sea Grant has also funded research into the economic influence of natural resource- based tourism, which appears to be significant. Lake Erie Coastal Ohio, Inc. is a not-for-profit formed to connect Ohio's historical and natural sites along Lake Erie and attract resource based travelers. This organization has promoted recreational activities associated with Lake Erie and Maumee Bay.

Additional information on the business and industry located along the shore of Maumee Bay is included in the watershed assessment reports.

2.3.4 Labor Force, Employment and Income: Information related to labor force, employment and income is covered in the related watershed assessment reports.

2.3.5 Property Values and Tax Revenues: Waterfront property values are dependent on the aesthetic and recreational value of Maumee Bay, and are generally higher than similar properties inland. A recent study (Ohio Sea Grant, 2008) demonstrated that water clarity had the greatest impact on home price, with increased clarity of two meters resulting in an average increase in home value of \$4,308. In addition, homes close to a beach on Maumee Bay are, on average, priced \$7,470 higher than an equivalent house located 10 miles away.

2.3.6 Natural Resource- based Recreation: Numerous marinas and associated facilities are located along North Maumee Bay, the Ottawa River, the Maumee River (Toledo Harbor) and other protected areas along the bay. Marinas provide seasonal dockage and storage, launch ramps, transient docking, hull and engine repair and services, fuel, ice and water, electricity, sewage pump-out, marine supplies and associated upland facilities (e.g., parking, restrooms, restaurants, fish cleaning stations.) Thousands of boats operate out of the Bay area. Numerous charter-fishing operations also operate out of the Bay area. Since the Bay is very shallow, federal and local navigation channels are also important to many large recreational vessels, particularly those with deep draft fixed-keels. Demand for water oriented recreational facilities continues to grow. This may be attributed to several factors, including community development changes, improved water quality and increased income and leisure time (USACE, 2002).

Two large game/refuge areas are located in the WLEB. The Erie Marsh State Game Area (includes Woodtick Peninsula) is located in Michigan in the vicinity of North Maumee Bay. The Cedar Point National Wildlife Refuge is located just southeast of Maumee Bay and Cedar Point. Carland Beach is located just north of Dry Tree Point. Cullen Park, Detwiler Park, Bayview Park and Maumee Bay State Park are located along the southern shore of Maumee Bay. These parks provide a number of activities including beaches, hiking/biking trails, picnic areas, fishing and boating access, and golf courses (USACE, 2002).

2.3.7 Public Facilities and Services: Within the Toledo area, the project vicinity is serviced with water, sewer, gas, electric, telephone, police, fire, emergency (rescue) medical, transportation, and sanitation facilities. All of the various utility agencies and companies that serve the area have facilities in, provide service to, or are otherwise tied to the harbor and Maumee Bay shoreline communities in some way.

The Cities of Toledo and Oregon water intakes extend into Lake Erie (12,000 ft and 4,800 ft respectively) from just east of Cedar Point and the Cedar Point National Wildlife Refuge. Toledo's 120 million gallons per day (mgd) capacity system (80 mgd average) serves over 500,000 residents plus industrial customers. Oregon's 16 mgd system serves over 25,000 residents plus industrial customers. Facilities have been periodically modernized and are expected to meet projected needs for some time into the future. The intake is near Maumee Bay, but technically lies outside the area commonly defined as the bay.

The Toledo (sewage treatment) Facility Planning Area services approximately 350,000 residents and pre-treatment industry needs. Toledo owns and operates wastewater treatment facilities and a collection system within its corporate limits. The Toledo Bay View Waste Water Treatment Plant (WWTP) is located just northeast of the river at the mouth of the Maumee River. The WWTP provides treatment services to a number of adjacent areas. The Toledo Bay View WWTP has an average daily capacity of 102 mgd. Older parts of the city (~22%) are served by combined sewers which carry both sanitary waste and storm runoff. Presently, there are 17 associated combined sewer overflows along the Maumee River. The Bay View WWTP has treated an average of 73 mgd over the past decade, which is 11 mgd less than the previous decade. This reduction in flow is due to sewer system improvements, improved flow monitoring, loss of population and industry. The system has undergone a number of improvements over the years that have improved treatment and/or reduced sewage discharges. Most sewage sludge is applied to area agricultural land for beneficial use in soils.

Water quality violations of dissolved oxygen and fecal coliform are frequently recorded in the Maumee River and Bay. The primary reasons for violations are combined and sanitary sewer overflows, urban runoff, failed septic systems, and upstream non-point source inputs.

The Oregon Facility Planning Area services approximately 30,000 residents and pre-treatment industry needs. The City of Oregon owns and operates wastewater treatment facilities and collection systems within its corporate limits. The waste water treatment plant is located off of Dupont Road (east of BP Refinery and south of Toledo Edison Bay Shore Plant) and provides treatment services to a number of adjacent areas. The treatment plant is capable of treating eight mgd on a normal basis, and also treating 36 mgd during wet weather (with room for expansion). An outflow facility is located in the embayment just south of the Toledo Harbor active CDF facilities. The plant is expected to have capacity for future needs. The main challenge facing Oregon will be to serve unsewered areas. Package plants and, in particular, failed septic systems, are a serious problem.

Toledo Harbor is one of the most active ports on Lake Erie and the Great Lakes- St. Lawrence Seaway System. Toledo Harbor Light is 72 feet above the water and has a square brick buff colored dwelling with an attached fog signal house. It is located on the northwest side of the entrance channel about 8.5 miles northeast of the river mouth. The light is listed on the National Register of Historic Places. Maumee Bay Entrance Light 2, about eight miles northeast of the Toledo Harbor Light, is equipped with a radar transponder and fog signal. A Coastal Guard Marine Safety Office is located at Toledo on the northwest side of the mouth of the Maumee River. The Toledo Harbor Patrol maintains an office adjacent to the Coast Guard Station. Toledo is served by nine railroad lines and has good highway connections. Several airports are located near the city.

2.3.8 Quality of Life, Health, Safety and Aesthetics:

Noise and Aesthetics. Noise and aesthetics in the harbor area are associated with various harbor area developments such as navigation facilities, industrial and commercial development, transportation facilities recreational facilities (primarily parks, marinas), and nearby residential developments. Primary sources include industrial developments, and noise generated by motorized vehicles (e.g., ships, boats, autos, trucks, trains, planes.) Areas of higher aesthetic value include shoreline areas with a view to or from the lake, park, marinas, and some residential and/or commercial (i.e. restaurant) areas. Areas of lower aesthetic value include dilapidated former shorelines and some dilapidated upland developments (USACE, 2002).

Community Cohesion. Community cohesion is a function of various social and economic factors. Many in the Toledo area are long time residents and community pride/cohesion is relatively strong. The harbor has played an important part in fostering community cohesion, as has the pursuit of environmental and recreational opportunities in the Maumee Bay area. (USACE, 2002). Most community interests agree that the harbor operations should be maintained to facilitate commerce and industry and associated community economic and social well being.

2.4 Cultural Characteristics

The identification of significant cultural resources in the Maumee Bay study area was accomplished via consultation with the National Register of Historic Places (NRHP)/National Park Service, the Ohio State Historic Preservation Office (Ohio - SHPO) and local interests. The NRHP listed three harbor-related properties, as depicted in Figures 2-5, 2-6 and 2-7: Toledo Harbor Light; Toledo Yacht Club at Bay View Park; and West Sister Island Light (USDOI-NPS, 2007) Cultural dimensions of federal projects in the harbor (e.g., dredging, open-lake placement, CDFs) have been addressed, as needed, via planning/NEPA study/report coordination and documentation.

2.5 Institutional and Regulatory Setting

A multitude of public and nongovernmental organizations is associated with research, management and regulatory activities relating to Maumee Bay. This complexity is due to both the geographic characteristics of the resource (i.e., multi-state and international dimensions) as

well as to the intensive, multiple use nature of the Bay's resources. The following discussion highlights the various roles and responsibilities of selected entities within the Maumee Bay institutional setting. It is recognized that there are additional entities with a role or interest in Maumee Bay at some level.

2.5.1 Public Agencies and Programs: Table 2-1 identifies counties and other governmental units (incorporated and unincorporated) with shoreline on Maumee Bay. Incorporated areas have authority to regulate land use, while counties possess the authority to regulate land use in unincorporated areas.

Local/regional agencies with watershed- related management authorities and interests are listed in Table 2-2. Ohio State government agencies with watershed- related missions and services are summarized in Table 2-3. Federal agencies with watershed- related programs are summarized in Table 2-4 and interstate and international organizations are listed in Table 2-5.



Figure 2-5 Toledo Harbor Light.



Figure 2-6 Toledo Yacht Club.



Figure 2-7 West Sister Island Light.

Table 2-1. Local governmental units along the Maumee Bay shoreline.

County	Other Governmental Unities	
	Cities/Villages	Townships (partial list)
Lucas County, Ohio	Toledo Oregon	Washington Jerusalem
Monroe County, Michigan	None	Erie

Table 2-2. Local/regional agencies with Maumee Bay missions and authorities.

Agency	Mission/Authorities	Watershed Services
Lucas County	Provides professional planning services for the City of Findlay and Hancock County and is responsible for enforcement of the Hancock County Subdivision Regulations	Management subdivision regulations including floodplain management, zoning, stormwater regulations for unincorporated areas
City of Toledo	Comprehensive planning and program implementation within Allen County and its various communities	Land use planning
Toledo Harbor	Deep draft commercial harbor	Channel dredging maintenance
Toledo Metropolitan Area Council of Governments (TMACOG)	Provides technical expertise and coordination for regional projects.	Restoration projects, stormwater planning, and environmental planning.

Table 2-3. State agencies with Maumee Bay missions and authorities.

Agency	Mission/Authorities	Watershed Management Services
Ohio Department of Development	Planning and financial assistance/incentives for economic development in Ohio	Grants for water lines, sanitary sewers and storm sewers and encourages sustainable green development.
Ohio Department of Natural Resources - Division of Geological Survey	Geologic information and services needed for responsible management of Ohio's natural resources	Maintains records of all geologic information in the state, as well as geologic samples, and provides scientific reports on geologic topics. Lake Erie related work includes the geology of Lake Erie, coastal erosion statistics, coastal management programs and coastal marsh restoration projects.
Ohio Department of Natural Resources – Division of Wildlife	Research, survey, and monitoring services for fish and wildlife resources	Assess and manage fish populations and fisheries in Lake Erie's Western and Central basins and their tributary streams.
Ohio Department of Natural Resources – Office of Coastal Management	Provide Coastal Resource Stewardship	Administers Coastal Management Program, provides education and outreach, and restores and protects coastal resources.

Table 2-3. State agencies with Maumee Bay missions and authorities.

Agency	Mission/Authorities	Watershed Management Services
Ohio Environmental Protection Agency – Division of Surface Water	The Division of Surface Water is responsible for restoring and maintaining the quality of Ohio's rivers and streams. The goal of Ohio's surface water program, restoration and maintenance of Ohio's water resources, reflects the national water quality objective as contained in the Federal Clean Water Act (CWA).	Participates in many Lake Erie programs including Maumee RAP, the Lakewide Management Plan and Phosphorus Task Force.
Ohio Environmental Protection Agency- Division of Environmental and Financial Assistance	Administers the Water Pollution Control Loan Fund, the Drinking Water Assistance Fund, and the Village Capital Improvements Fund	Loans for WWTP upgrades, stormwater, WRSSP Program.
Ohio Water Development Authority	Provides financial assistance for environmental infrastructure	Drinking water funding, sewer funding, stormwater funding, emergency assistance, Lake Erie costal erosion projects, dam safety and solid waste projects.

Table 2-4. Federal agencies providing Maumee Bay related services.

Agency	Mission/Authorities	Watershed Services
Federal Emergency Management Agency	Reduces loss of life and property	Floodplain mapping, disaster mitigation, natural disaster mitigation planning assistance
National Oceanic and Atmospheric Administration	Understands and predicts changes in the earth's environment and conserve costal and marine resources	Threatened and endangered species, coastal zone management and Lake Erie research.
U.S Environmental Protection Agency	Restores and maintains watersheds and their ecosystems to protect health, support economic development and recreational activity, and provide healthy habitat for fish, plants, and wildlife	Watershed data and information, Best Management Practices, information/ education and Lake Erie research.
U.S. Army Corps of Engineers	Investigates, develops and maintains the nation's water and related environmental resources	Water resources planning, shore protection, flood studies, wetland permitting, habitat assessments and hydrographic information
U.S. Fish and Wildlife Service	Provide the Federal leadership to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of people.	Endangered species by region/state, national wetland inventory, habitat and wildlife, wetlands. Manages Cedar Point National Wildlife Refuge.
U.S. Geological Survey U.S. Geological Survey – Ohio Div. U.S. Geological Survey – Michigan Div.	Provides information to minimize loss of life and property from natural disasters, manage water, biology, energy and mineral resources, and enhance and protect quality of life.	Prepares topographic, floodplain and other maps; gathers stream flow and other water data; and undertakes special studies

Table 2-5. Interstate and International organizations providing Maumee Bay related services.

Agency	Mission/Authorities	Watershed Services
International Joint Commission	<p>The International Joint Commission prevents and resolves disputes between the United States of America and Canada under the <i>1909 Boundary Waters Treaty</i> and pursues the common good of both countries as an independent and objective advisor to the two governments.</p> <p>In particular, the Commission rules upon applications for approval of projects affecting boundary or transboundary waters and may regulate the operation of these projects; it assists the two countries in the protection of the transboundary environment, including the implementation of the <i>Great Lakes Water Quality Agreement</i> and the improvement of transboundary air quality; and it alerts the governments to emerging issues along the boundary that may give rise to bilateral disputes.</p>	Canada and the United States created the International Joint Commission because they recognized that each country is affected by the other's actions in lake and river systems along the border. The two countries cooperate to manage these waters wisely and to protect them for the benefit of today's citizens and future generations.
Great Lakes Commission	The purpose of the Commission is to carry out the terms and requirements of the Great Lakes Basin Compact, as noted in Article 1: To promote the orderly, integrated, and comprehensive development, use, and conservation of the water resources of the Great Lakes Basin.	The Great Lakes Commission provides communication and education, information integration and reporting, facilitation and consensus building, and policy coordination and advocacy services of value to stakeholder groups within the region.
Council of Great Lakes Governors	To encourage and facilitate environmentally responsible economic growth. This has been accomplished by establishing a cooperative effort between the public and private sectors among the eight Great Lakes States, Ontario and Québec. Through the Council, Governors work collectively to ensure that the entire Great Lakes region is both economically sound and environmentally conscious in addressing today's problems and tomorrow's challenges.	The Council works directly for the eight Great Lakes Governors on projects and issues of common concern. The Council develops, implements, and coordinates project-specific initiatives to improve the region's environment and economy.

2.5.2 Non- governmental Organizations and Programs: This category includes non-profit, non-governmental organizations concerned with watershed related issues. Table 2-6 presents a representative listing of organizations active in Maumee Bay.

Table 2-6. Non-governmental organizations and programs.

Agency	Program Description/Responsibilities	Watershed Services
Ducks Unlimited	Conserves, restores and manages wetlands and associated habitats for North America's waterfowl	Wetlands restoration and conservation services, farm bill support, and conservation programs
Environmental Defense Foundation	Works with landowners, businesses, indigenous groups and others to restore ecosystems and protect biodiversity	Provides habitat and river restoration services; promotes expanded incentives for private lands stewardship; advocates on law and policy issues
Joyce Foundation	Supports efforts to protect the natural environment of the Great Lakes	Provides grant funding programs for restoring river ecosystems, and advocating investment in Great Lakes restoration
Ohio Environmental Council	Work with individuals, government, local groups and businesses to enhance the quality of life in communities and sustain natural systems	Advocacy, education and outreach, grant funding, environmental watch services
The Nature Conservancy – Ohio Chapter	Protects ecologically important lands and waters	Habitat and species protection, restoration and conservation programs

2.5.3 Regulatory Framework for Watershed Management: Maumee Bay is subject to a broad range of federal, state and local regulations and programs pertaining to water quality, water supply, coastal wetlands protection, commercial navigation, commercial and sport fishing and threatened and endangered species. Table 2-6 provides an overview.

Table 2-6. Summary of Maumee Bay management regulations.

Regulatory Program/Requirement	Description	Implementing Agency
Long Term Control Plans	The LTCP is a plan with a schedule to control CSO discharges to the area waterways	Municipalities, USEPA, Ohio Environmental Protection Agency
NPDES Industrial Permit	Dischargers with a storm water discharge associated with industrial activity that is discharged via a point source (including discharges through a municipal separate storm sewer system) to surface waters of the state are required to obtain coverage under this program	Ohio Environmental Protection Agency
Phase II MS4 Permits	General permit for the statewide regulation of Small Municipal Separate Storm Sewer Systems (MS4) to discharge storm water	Ohio Environmental Protection Agency
TMDLs	A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources	Ohio Environmental Protection Agency

2.6 Trends, Issues and Implications for Watershed Protection and Management

Trends, issues and implications for waterbody protection and management based on the above existing conditions are summarized as follows:

- Urban point and nonpoint sources of pollution exist near the bay and contribute to water quality issues. Local nonpoint pollution problems are subject principally to non-regulatory based BMP initiatives at the federal, state and county levels.
- Phosphorus and sediment are two pollutants with substantial impact on the water quality of Maumee Bay. They contribute to water clarity, hypoxia, and habitat degradation.
- Economic impacts are tied to water quality impacts. Dredging sediment largely contributed by upstream watershed and degrading fishery impact the local and regional economy.

In the following sections, the Maumee Bay assessment focuses on five areas specified in Sec. 441 of the Water Resources Development Act. Potential actions for improving watershed health and solving watershed flooding problems are presented.

- Section 3: Lake Levels, Water Supply, and Sedimentation
- Section 4: Water Quality
- Section 5: Resource-Based Recreation
- Section 6: Fish and Wildlife Habitat
- Section 7: Commercial and Recreational Navigation

3. WATER LEVELS, WATER SUPPLY, SEDIMENTATION AND EROSION

3.1 Introduction

The purpose of this section is to identify and assess existing problems, needs, opportunities and trends in Maumee Bay and to document findings and identify potential actions. The following subsections address issues that include land use, lake levels, water supply, sedimentation and shoreline erosion.

3.1.1 General Land Use Characteristics: Land use within the Maumee River watershed, has a profound impact on water quality in Maumee Bay. The watershed delivers pollutants that lead to cultural eutrophication and dredging requirements, and is linked to declines in the Lake Erie fishery.

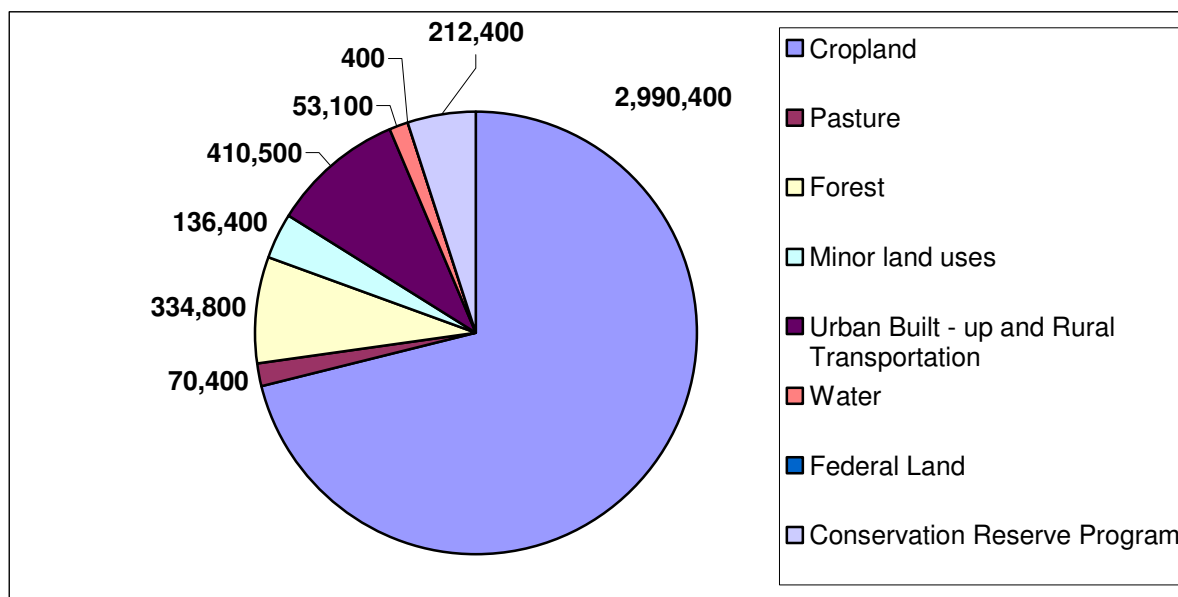


Figure 3.1 Land Cover of the Maumee Bay Watershed.

Near shore land use (e.g., harbors, industry, wildlife refuges, urban areas, islands) also has an influence on Maumee Bay, as it impacts aquatic and terrestrial habitat, economic growth, recreational activities and non point and point source pollution.

Land cover within the Maumee watershed is described in Figure 3.1. Detailed data and information, including maps and areas of the watersheds contributing flow to Maumee Bay, are included in the individual watershed assessment reports.

3.1.2 Drainage Areas by Political Subdivisions: The drainage to Maumee Bay includes three states (i.e., Michigan, Ohio, and Indiana); dozens of counties; and hundreds of cities, towns and villages. The population is over 1.2 million people, and density is depicted in Figure 3-2.

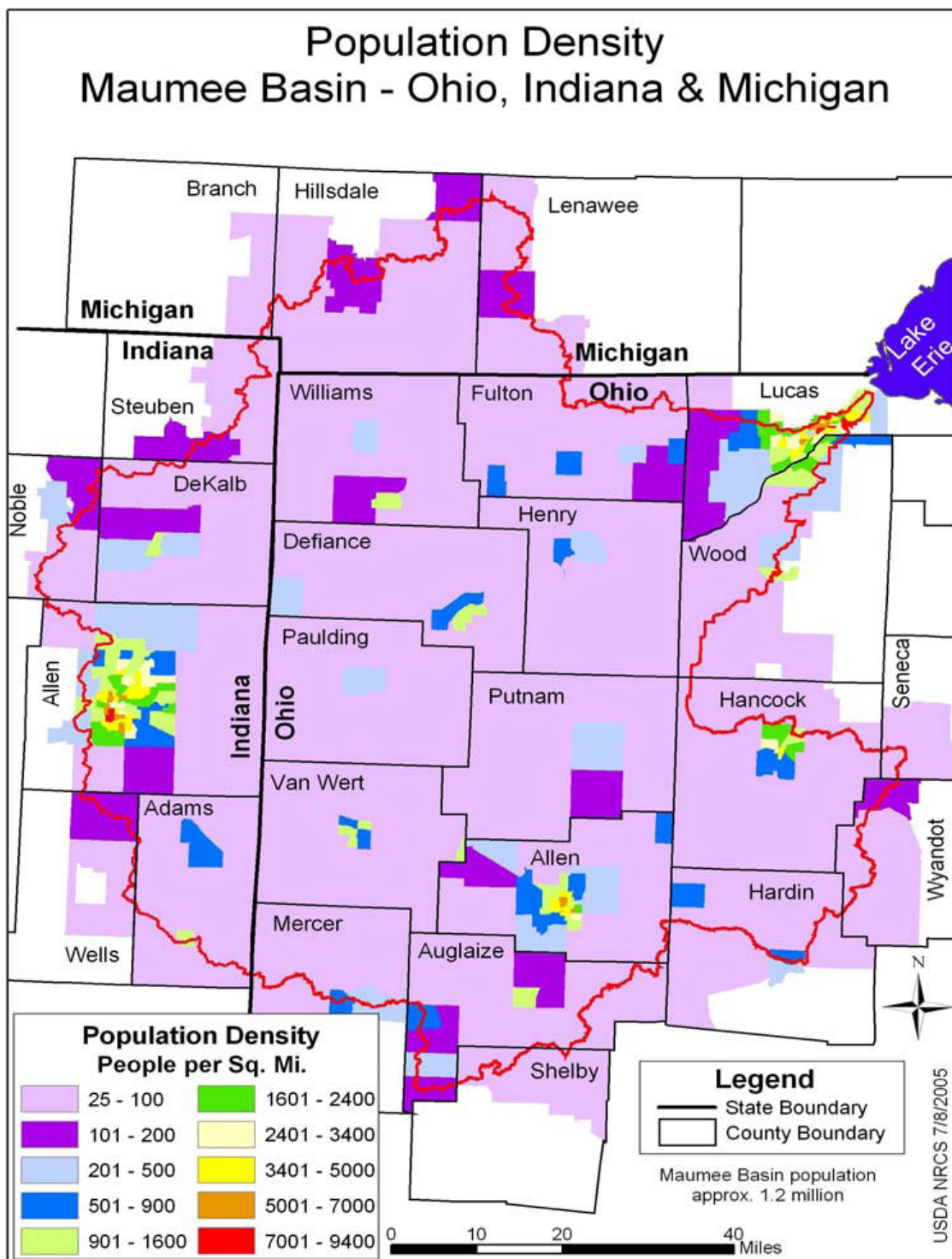


Figure 3-2. Population density and distribution within the Maumee Basin watershed.

Units of government and major public facilities with shoreline on Maumee Bay include Monroe County, Michigan; Lucas County, Ohio; Toledo, Ohio; Oregon, Ohio; Maumee Bay State Park; and Cedar Point National Wildlife Refuge.

Detailed population estimates (by county) within the Maumee River watershed are included in individual watershed assessment reports.

3.1.3 General Flow Conditions: Maumee Bay is influenced by flows from each of the various watersheds draining into it, as well as by conditions in the larger Lake Erie Basin. Details are provided in the individual watershed assessments for the WLEB.

Water levels in Maumee Bay change on short and long term time scales. Short term changes (hours, days and weeks) can occur due to seiche or storm events that may entail consistent winds and increased flow. Longer term water level changes are influenced by seasonal variations due to precipitation patterns, snow melt and/ or extent of ice cover (affecting evapotranspiration rates). The prospective impacts of climate change, which may result in a permanent lowering of Great Lakes water levels factor into long term time scales as well.

3.1.4 Sources of Water Data for Maumee Bay: Several public agencies, universities and nongovernmental organizations collect water resource- related data in Maumee Bay. Much of this data can be found in peer reviewed papers, scientific studies and government reports. Selected agency/ university programs are as follows:

- NOAA measures water level, wind speed, air pressure, air temperature and relative humidity near Toledo, Ohio. The agency also supports water quality monitoring through grants to colleges and universities, such as Bowling Green State University.
- USGS includes Maumee Bay in its Lake Erie-Lake St. Clair Basin National Water Quality Assessment (NAWQA) program, and collects and maintains a significant amount of water quality data.
- US EPA includes Maumee Bay in its Great Lakes monitoring efforts. Its limnology program is examining key environmental factors that influence the food chain and fish of the Great Lakes. Chloride, nitrate/nitrite, silica, phytoplankton, phosphorus, chlorophyll-a and dissolved oxygen are collected as part of this program. The agency's contaminated sediments program assists with the collection of sediment data in Areas of Concern (AOCs). The Great Lakes Environmental Database (GLENDa) provides storage of, and access to Great Lakes- related data.
- Ohio EPA maintains a sediment inventory program that focuses on metals, industrial contaminants and nutrients within Lake Erie.
- The University of Toledo's Lake Erie Center collects and analyzes data on water quality, ecological conditions, land use and hydrology. Numerous scientific papers have been published by researchers working from the Lake Erie Center.

3.2 Water Supply

Maumee Bay is not used as a drinking water supply, but does provide water for industrial

Table 3-1 Maumee Bay water withdrawal data for 2005 and 2006.

Category	2005 Volume (MG)	2006 Volume (MG)	Number of Intakes
Industrial	17,281	16,420	1
Power Generation	266,702	272,254	1

and power generating activities (see Table 3.1). The City of Toledo's water intake is east of Cedar Point National Wildlife Refuge outside of the Bay), but may still be influenced by activities in the Bay (Figure 3-3).



Figure 3-3. Location of City of Toledo's water intake relative to Maumee Bay and glass of untreated water from Lake Erie (T. Bridgeman).

3.3 Flood Control Infrastructure, Flood Characteristics, Programs and Best Management Practices

Major floods on the Maumee River have been recorded as early as 1832, with the largest having occurred on March 26, 1913 with an estimated discharge of 180,000 cfs and recurrence frequency greater than 500-years (FEMA, 2000). Significant flooding was also observed in 1913 along the Ottawa River. Severe flooding along the bayshore occurred in March 1973, April 1974 and March 1975, with the worst flood of recent record occurring in November 1972. (Flooding

associated with the Maumee and Ottawa Rivers is discussed in their individual watershed reports.)

The Point Place area, which sits on a peninsula between Maumee Bay and the Ottawa River, is currently protected by levees installed by USACE in the 1980s. Recently, the agency has considered removing the levees' accreditation, requiring protected residents to purchase flood insurance. USACE and municipal officials are working together to assess the risk of flooding and the condition of the levees.

3.3.2 Extent of Drainage Controls in Place (levees, other features, diversions): Levees exist along the north edge of the bay, and protect the Erie Marsh area owned by the Nature Conservancy. Breakwalls along Point Place are designed to mitigate shoreline erosion and flooding.

3.3.3 Floodplains, Status of Mapping: Flood Insurance Studies (FIS) investigate the existence and severity of flood hazards under the authority of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Flood Insurance Rate Maps (FIRMs) were developed for Monroe County, Michigan and Lucas County, Ohio as part of these investigations (FEMA,2007).

3.4 Existing Conditions: Problems and Concerns

In this section, existing conditions (problems and concerns) are summarized based on WLEB Partnership comments, public input from the workshops, and information and reports reviewed.

3.4.1 Water Supply: Maumee Bay supplies water for industrial use and power generation. Local municipalities (Toledo and Oregon) receive water from Lake Erie outside of the Maumee Bay study area. Supply is not a concern at this time but, over the long term, any climate change- related impacts (e.g., lower water levels) may be of concern. Sources of contamination that threaten the quality of water are addressed in the individual watershed assessments, and their impact on Maumee Bay is described in detail in Section 4.

3.4.2 Flood Risk Management and Flood Control: Flood risk management and flood control problems are described in the individual watershed assessments.

3.4.3 Sedimentation and Stream Bank Erosion: Streambank erosion issues are covered in individual watershed assessment reports. Shoreline erosion along Maumee Bay tends to be a localized problem, as much of the shoreline is developed with adequate protection. Lake Erie Marsh has experienced some erosion issues and shoreline protection may be needed. Maumee Bay is the receiving water of the Maumee River and, as such, has problems associated with the river's historically substantial sediment loads. Principal among them is the impact on navigation channels and the costs and disposal issues associated with dredging requirements. These impacts have prompted a number of studies and soil erosion/ sediment control programs to be initiated in contributing watersheds upstream. (Streambank erosion issues are covered in individual watershed assessment reports.)

3.5 Anticipated Conditions - Opportunities and Unmet Needs

The primary concern related to water levels, water supply, sedimentation and erosion is associated with the costs for dredging navigation channels. As noted above, projects in contributing watersheds have been initiated to reduce sediment load to Maumee Bay in an attempt to reduce dredging requirements.

3.5.1 Water Supply: As noted above, municipalities along the shoreline access water supplies from outside the Maumee Bay study area. Potential concerns associated with water supply include degraded water quality (resulting in increased treatment costs), invasive species

impacts on infrastructure (e.g., zebra mussels attaching to intake structures); and future water level changes (due to short or long term precipitation/ snowmelt patterns.)

3.5.2 Flood Risk Management and Flood Control: Flooding due to high water levels in Maumee Bay has occurred over time, with problems concentrated at Point Place and other low areas along the Bay. The Lake Erie seiche effect can be particularly pronounced in the Maumee Bay and Toledo Harbor area. A levee system at Point Place was constructed in 1986 to protect the peninsula; it is currently undergoing an evaluation to determine if risk is sufficiently reduced to eliminate the requirement for federal flood insurance. Maumee Bay State Park is protected from flooding problems by detached breakwaters installed when the park was constructed.

3.5.3 Sedimentation and Stream Bank Erosion: Sedimentation of Maumee Bay is an ongoing problem, as evidenced by the significant and ongoing dredging requirements for the commercial navigation channels. Erosion is a localized problem along the shoreline and is more pronounced during storm events and periods of higher water levels. Some developments along the shoreline limit potential erosion problems through installation of structures. For example, the Maumee Bay State Park shoreline is protected from erosion by permeable boulder stone revetments, a concrete sea wall, groins and detached breakwaters.

Streambank erosion control is important to Maumee Bay, given that sediment input from upstream sources has adverse implications for water quality, fish and wildlife habitat, recreation/ aesthetics and commercial dredging requirements. Details regarding the extent of streambank erosion problems, needs and opportunities are addressed in each of the individual watershed assessments. Impacts to water quality of Maumee Bay are addressed in Section 4 of this report.)

3.6 Past/ Ongoing Studies and Data Gaps

Table 3-2 summarizes past/ongoing studies and data gaps in the watershed.

Table 3-2. Sediment, erosion and water supply past, ongoing studies and data gaps.

WLEB Resource Category	Name of Study	Description	Political Subdivision/Agency
Sedimentation, erosion control	Natural Resource Management Plan – Maumee Bay Region	Describes restoration activities needed to restore areas impacted by development of the Maumee Bay State Park.	US Fish and Wildlife Service
Sedimentation, erosion control	Maumee Bay Sediment Transport Mechanisms During Spring Runoff	1978 report identifying extent of lake degradation due to excessive springtime sediment runoff.	US EPA and IJC
Sedimentation, erosion control	Lake Erie Protection and Restoration Plan 2008	Section on Coastal Health discusses plans to restore beaches and shoreline habitat	Ohio Lake Erie Commission
Sedimentation,	Sediment Trend Analysis in	Describes sedimentation trends	USACE

Table 3-2. Sediment, erosion and water supply past, ongoing studies and data gaps.

WLEB Resource Category	Name of Study	Description	Political Subdivision/Agency
erosion control	Maumee Bay, Lake Erie	in Maumee Bay over time and discusses disposal areas and impact on channel dredging.	

3.7 Findings

The Maumee Bay shoreline is highly developed, featuring the population centers of Toledo and Oregon, neighboring suburbs, and several heavily used parks. High concentrations of residents, buildings and public infrastructure translate into high potential costs associated with damage from flooding and erosion events. The Maumee River represents the single largest sedimentation pathway into Maumee Bay, and resulting deposition requires costly, ongoing dredging to maintain commercial navigation channels.

3.8 Potential Actions: Table 3-3 identifies potential actions needed to restore erosion sites and sedimentation areas in the watershed. This list warrants consideration by the WLEB Partnership as potential actions are prioritized.

Table 3-3 Flood risk management, flood control, water supply, sedimentation and streambank erosion potential actions.

Description:	Potential Sponsors	Costs Estimates	Time Frame
Control shoreline erosion at Maumee Bay State Park.	Maumee Bay State Park	\$500,000	2010-2012
Implement pilot studies related to shore erosion.	ODNR	\$50,000	2010-2014
Finalize Lake Erie Shore Erosion Management Plan.	ODNR	\$25,000	2010-2012
Publish coastal design manual.	ODNR	\$10,000	2010

4. WATER QUALITY

4.1 Introduction

Maumee Bay is the shallowest portion of Lake Erie with an average depth less than six feet and a hydraulic residence time of approximately five days. Prior to entering Lake Erie, the Maumee River flows through flat agricultural land where it collects considerable sediment load,

The Maumee River delivers an estimated 50% of the sediment load to the Western Lake Erie Basin and 2,240 tons of Phosphorus annually.

nutrients and pesticides. Several urban areas, including Toledo, further degrade river water quality via runoff and wastewater discharges contaminated with metals and polycyclic aromatic hydrocarbons (PAHs) as well as traditional pollutants. The Maumee River delivers an estimated 50% of the sediment load to the Western Lake Erie Basin and 2,240 tons of Phosphorus annually, contributing to and exacerbating myriad water quality issues.

While many of these water quality issues are commonly associated with agricultural and urban runoff, some are unique to lake environments. Lower dissolved oxygen levels, algal blooms, elevated levels of coliform bacteria, turbidity and suspended solids are known issues in the Bay. Typically, water quality varies spatially within the Maumee River system, degrading as it passes the urbanized areas in the lower river and then improving lakeward from the river mouth. Water quality problems have lead to beach closings, loss of fish habitat, reduced recreational opportunities and the appearance of hypoxia within Maumee Bay.

4.2 Water Quality Characteristics

Water quality in Lake Erie has been studied extensively over the past several decades. During the 1960s and 1970s the lake underwent eutrophication due largely to phosphorus loads. The resultant algal blooms and lowered dissolved oxygen levels led to numerous fish kills and a dead zone within the lake. Since then, phosphorus loadings have decreased significantly, by some estimates over 83%. By the late 1980s, several programs had been implemented that focused on reducing phosphorus. Observed improvements during the 1990s may indicate that these controls have been at least partially successful; however, the recent re-emergence of Lake Erie hypoxia also indicates that the problem may need more research and that the nutrient issue has not been resolved.

Western Lake Erie has a unique set of environmental and water quality issues beyond those that affect the entire lake. As the single greatest source of suspended solids in the Great Lakes system, the Maumee River produces a sediment plume that can stretch up to 50 km into the lake. Phosphorus-rich sediment inhibits sunlight from reaching into the water column and, under certain conditions, the decay of this excess organic material may consume oxygen on the lake bottom faster than can be replenished, leading to low oxygen conditions, sometimes referred to as hypoxia or a “dead zone”.

Maumee Bay, Toledo Harbor and the lower segments of Maumee River and Ottawa River experience seiche activity that can resuspend sediments and alter water depths within a few hours. The waters of Maumee Bay are more turbid than the open lake, but less turbid than at the mouth of the Maumee River (USACE-Buffalo, 2002). Most turbidity occurs in the spring season during heavy runoff events.

Since 2002, the University of Toledo has been monitoring the water quality of Maumee Bay and, more generally, the WLEB. Monitoring cruises have been conducted at 10-14 day intervals between April and October to establish baseline water quality conditions. This data is used to establish seasonal trends and understand the influence of the Maumee River in determining offshore water quality. These sampling efforts have been used to record episodic events; natural phenomenon that are brief enough to be missed by routine monitoring, but important enough to have effects that may linger for months or years.

Some episodic events that have been detected and tracked during these studies include invasive species, algal blooms and hypoxia. Western Lake Erie is often severely affected by colonization of invasive species. Both *Cerccopagis pengoi* and *Daphnia lumholtzi* have been studied by University of Toledo researchers. In August 2003, a massive bloom of the cyanobacteria *Microcystis aeruginosa* formed in western Lake Erie and lasted for nearly a month. *Lyngbya wollei* (Figure 4-1) is another invasive specie that was first found in Maumee Bay in 2006.



Figure 4-1. *Lyngbya wollei* washes on the shore in thick mats, sometimes making mounds five feet high (Photo by Mark Brush).

4.3 Water Quality Infrastructure, Programs and Best Management Practices

Many of the programs that impact the water quality of Maumee Bay are focused on reducing point and nonpoint source pollutants. As such, many of the infrastructure, programs and Best Management Practices that affect the Maumee Bay are discussed in the related watershed reports. Programs directly related to the water quality of Maumee Bay focus on assessing current water quality trends and indicators of ecological health. These programs include:

- The US EPA Western Lake Erie Basin Indicator Project is developing and applying numerous indicators of ecosystem health in Lake Erie. Many are related to water quality issues of concern in Maumee Bay.
- The USGS NAQWA Program is enhancing understanding of water quality conditions, changes over time, and the affect of human activities on water quality.

- The Ohio Sea Grant Program funds a broad range of Lake Erie research, with topics that include aquatic ecology, low dissolved oxygen conditions, invasive species, pollution control actions, and wetland protection and restoration.
- The Great Lakes Research Consortium, comprised of 18 colleges and universities in New York and Ontario, is conducting research on multiple topics including harmful algal blooms.
- The Lake Erie Lakewide Management Plan (LaMP) is a collaborative public/nongovernmental effort (under the Great Lakes Water Quality Agreement) to establish goals and objectives for the lake basin and coordinate efforts to achieve them.
- The Lake Erie Unit of the Ohio EPA Division of Surface Water is developing a Remedial Action Plan (RAP) for the Maumee Area of Concern, assisting with development of the Lake Erie Lakewide Management Plan, and supporting a Phosphorus Reduction Task Force.
- The ODNR Coastal Management Office administers the Ohio Coastal Management Program, which guides the protection, use and development of coastal areas through plan development and implementation.
- The NOAA Great Lakes Environmental Research Laboratory (GLERL) is coordinating the International Field Years on Lake Erie, an intensive research program initiated in 2005 and focusing in part on low dissolved oxygen and harmful algal blooms.

Hypoxia or 'dead zones' are areas of oxygen depletion, in which little to no life can be sustained.

4.4 Existing Conditions - Problems and Concerns

Table 4-1 summarizes water quality problems and concerns in Maumee Bay, as gleaned from relevant reports.

Table 4-1. Water quality problems and concerns.

WLEB Resource Category	Name	Description	Political Subdivision
Water Quality	Beach closings	Elevated levels of bacteria from diffuse nonpoint sources has been measured at Maumee Bay State Park beaches	County Health Department
Water Quality	Phosphorus/ Low Dissolved Oxygen/ Algal Blooms	Nutrient loading from nonpoint sources and wastewater treatment plants leads to harmful algal blooms that lead to low dissolved oxygen within Lake Erie	US EPA, OEPA
Water Quality	Zebra Mussels	The zebra mussel is an invasive species; its filtering capacity has increased clarity in Lake Erie, counteracting (to a degree) turbidity problems	US EPA, OEPA and ODNR

Table 4-1. Water quality problems and concerns.

WLEB Resource Category	Name	Description	Political Subdivision
Water Quality	Turbidity	Suspended sediment from the Maumee River Basin, along with resuspension due to wave action and seiche, contribute to turbidity in Maumee Bay	US EPA, OEPA
Water Quality	Sediment Quality	Sediment grain size distribution and pollutant level are relevant to disposal methods of dredged materials.	USACE

Beach Closings. Beach closings occasionally occur within Maumee Bay at designated area swimming beaches. For example, the Lake Erie Beach at Maumee State Park had water quality advisories posted 12 times in 2006, 12 times in 2007 and 8 times in 2008. Bacteria concentrations in a single sample greater than 235 cfu/ 100 ml. trigger beach closings in Ohio. Twenty four percent of the samples collected at Maumee Bay State Park beach exceeded the state water quality criteria in 2007. Occurrences of high bacteria concentrations are the result of rainfall events that wash-off bacteria from urban, suburban and agricultural areas in the watersheds contributing flows to Maumee Bay.

Sediment Quality. USACE- Buffalo District has conducted extensive sediment and water quality testing in the Maumee River and Bay relating to Toledo Harbor maintenance dredging activities. These testing efforts show a gradual improvement in federal navigation channel (River and Lake Approach Channel) sediment quality over the last few decades.

USACE routinely samples and analyzes sediments from the River and Lake Approach Channels, as well as open-lake areas, in order to characterize Toledo Harbor dredged material in accordance with the Great Lakes Dredged Material Testing and Evaluation Manual (USEPA/USACE, 1998). In 2004, sediment samples were collected from the Lake Approach Channel (Lake Mile 0 through 10), and open-lake reference and placement areas (EEI, 2004). In 2006, sediment samples were collected taken from Lake Approach Channel (Lake Mile 0 through 2), the River Channel, and open-lake reference and placement areas (EEI, 2006). The sediments were subjected to physical, chemical and biological analysis. The material to be dredged consists primarily of silts, with some clays and fine sand. Recent analysis has shown all sediments in the River and Lake Approach Channels (except at River Mile 2 in the River Channel), meet Federal guidelines for open-lake placement (USACE, 2007). Accordingly, these sediments are to be placed at the existing open-lake placement area or possibly utilized as a component of a beneficial use project. Sediments dredged from River Mile 2 are to be placed into CDF 3 – Cell 2.



Figure 4-2. Zebra mussels are a common invasive species in Maumee Bay.

phosphorus has been attributed to the reductions in phosphorus entering Lake Erie; however, the re-emergence of hypoxia is a cause for concern and additional research to determine its source.

Hypoxia. Hypoxia or ‘dead zones’ are areas of oxygen depletion in which little to no life can be sustained. The excess phosphorus and organic materials in the WLEB can cause this phenomenon, which may occur several times each summer, if only for a brief period of time. The duration and severity of hypoxic episodes varies each year, and the effect on bottom-dwelling organisms is poorly understood. However, hypoxia is emerging as a problem in western



Figure 4-4. Sandy Binh and her neighbors are worried about the emergence of a new algae in the Lake - *Lyngbya wollei*. (Photo by Mark Brush)

Phosphorus. Phosphorus concentrations have been a problem in the WLEB since the 1970s. Nutrient enrichment in these areas supports excessive algal growth which results in nuisance algal blooms and adverse effects on the aquatic ecosystem. The Great Lakes Water Quality Agreements (GLWQA) as amended in 1983 recognized the damage caused by phosphorus and included a phosphorus abatement program in order to restore the lakes to a more natural state. In a study conducted by Nicholls et. al (2001) a significant downward trend in total phosphorus concentrations was noticed between 1976 and 1999. The overall long-term trend of declining total



Figure 4-3. *Lyngbya wollei* is an invasive algae that can clog up water intakes, such as this irrigation pump. (Photo by Mark Brush)

Lake Erie.

Invasive Species. Western Lake Erie is an invasive species hotspot and, along with Lake St. Clair, is often the first place in the Great Lakes that invasive species appear. The impact of the zebra mussel on western Lake Erie is particularly pronounced, as they have been shown to promote harmful algal blooms. Other invasive species, such as *Lyngbya wollei* (Figures 4-3 and 4-4) have appeared more recently. Their impacts are just beginning to be observed and documented.

Harmful Algal Blooms (HAB). Eutrophication is a natural aging process in lakes but is often accelerated by elevated nutrients from human

activities (primarily phosphorus.) This is evidenced by algal blooms covering the lake during the summer months; green algae called *Cladophora* covering rocky and man-made structures; decomposing algae on beaches; blue-green algae in municipal water supplies; and dissolved oxygen depletion in the lake.

Algal blooms caused by eutrophication first appeared in western Lake Erie in the 1960s. Provisions in the 1972 GLWQA led to a 60% reduction in phosphorus loading into Lake Erie and, consequently, reduced amounts of algae.

As filter feeders, zebra mussels are capable of removing much of the planktonic algae from the water. This led to several years of improved water clarity and dramatic food web changes, particularly a shift in algal production from phytoplankton to bottom dwelling algae and plants.

In the 1990s, large late-summer algal blooms began to reappear in western Lake Erie, comprised largely of blue-green algae *Microcystis aeruginosa*. This is a concern since *Microcystis* is poor food for zooplankton and contains a potent toxin called microcystin that causes liver damage. It appears from several research studies that these algal blooms are linked to nutrient loading, nutrients from zebra mussels, and selective feeding on specific types of algae from zebra mussels.

4.5 Anticipated Conditions - Opportunities and Unmet Needs

Water quality opportunities and needs in the Maumee Bay are summarized in Table 4-2.

Table 4-2. Water quality opportunities and needs.

WLEB Resource Category	Name	Description	Political Subdivision/Agency
Water Quality	Bacteria levels	Bacteria levels exceed Ohio Water Quality Standards Recreational Use criteria leading to beach closings; solutions to high bacteria levels should be developed.	County Health Departments, State Health Departments, OEPA
Water Quality	Sediment Deposition	Excessive sedimentation and nutrient inputs from agricultural erosion (e.g., runoff, wind) result in biological and chemical impairments: reduced clarity, habitat degradation and siltation. Sources may be addressed via riparian buffers, fencing livestock out of streams, proper fertilizer and pesticide application, avoiding winter land application of manure, implementation of LTCP, improved wastewater treatment and ceasing of traditional "cleaning" of streams.	NRCS, Soil and Water Conservation Districts, OEPA, ODNR, MDEQ, USEPA
Water Quality	Nutrients	Nutrients contribute to water quality degradation by stimulating excessive algal growth leading to hypoxia and reduced clarity. Sources include leachate from septic systems, land application of manure, inadequately treated domestic sewage, over- application of fertilizer, manure spills and inadequate riparian buffers. Identification of and reliable information about activities that contribute nutrients is	NRCS, Soil and Water Conservation Districts, OEPA, ODNR, MDEQ, USEPA

Table 4-2. Water quality opportunities and needs.

WLEB Resource Category	Name	Description	Political Subdivision/Agency
		critical.	
Water Quality	Invasive Species	Established populations of zebra mussels, quagga mussels and other non native species are found in Lake Erie, resulting in pronounced changes to habitat and water quality.	US EPA, OEPA, ODNR, MDNR, MDEQ, USFWS, USDA
Water Quality	Sediment Quality	Discharges of liquid and solid waste from industrial, agricultural and domestic sources have introduced a multitude of toxic substances into Maumee Bay, adversely impacting Great Lakes wildlife, biodiversity and aquatic ecosystems. Many contaminants bond to suspended particles which are subsequently deposited in open lake areas.	US ACOE, US EPA, OEPA, ODNR, MDNR, MDEQ
Water Quality	Algal Blooms	<i>Lyngbya wollei</i> is an invasive algae first documented in the WLEB in 2006, and is found attached to sediments in the lake.	US EPA, OEPA, ODNR, MDNR, MDEQ, USFWS

4.6 Past/ Ongoing Studies and Data Gaps

Table 4-3 summarizes past/ongoing studies and data gaps for Maumee Bay.

Table 4-3. Water quality past, ongoing studies and data gaps.

WLEB Resource Category	Name	Description	Recommendations
Water Quality	Wolf Creek Study, 2003 and Maumee Bay Bacteria Study 2003- 2005.	The Maumee Bay Bacteria Task Force conducted a study (via UT) to evaluate whether stream sediments contributed to bacteria concentrations during storm events.	Restore wetlands along creeks to trap and store sediment and bacteria. Eliminate failing septic tanks and install sewers. Continue to analyze water quality and sediment data to refine sources of bacteria.
Water Quality	Maumee Bay State Park Wetland Restoration Plan 2006-2007	Restore wetlands along Wolf Creek to reduce bacteria related to beach closures. They will function as a sediment and bacteria trap; reducing loading to the bay and bathing areas.	Conceptual plan for wetland system.

Table 4-3. Water quality past, ongoing studies and data gaps.

WLEB Resource Category	Name	Description	Recommendations
Water Quality	Maumee Bay State Park Stream Erosion Beach Restoration Study	Final Feasibility Report and Final Environmental Impact Statement: USACE- Buffalo District December 1983.	Provided assessment of shoreline erosion at Maumee Bay State Park property.
Water Quality	Maumee Bay and Western Lake Erie Water Quality Monitoring: A Final Report to the Lake Erie Protection Fund	Report describes a monitoring program that addresses emerging threats of hypoxia, invasive species, sediment deposition and clarity. Sampling included monitoring to develop base line data set, capture episodic events and characterize sediment oxygen demand.	The study resulted in a large data set of water quality data and information about western Lake Erie and Maumee Bay.
Water Quality	A Spatial, Multivariable Approach for Identifying Proximate Sources of Escherichia coli to Maumee Bay, Lake Erie, Ohio	Investigated the sources and spatial distribution of bacteria at Maumee Bay State park using advanced statistical techniques.	Concluded that bacteria are of local origin and could include sediment sources and nearby drainage ditches.
Water Quality	Genetic and environmental factors influencing Microcystis bloom toxicity	Forecast the development and toxicity of the harmful algal blooms, Microcystis and the toxin it produces.	Develop quantitative method to determine conditions that promote microcystin production.
Water Quality	Lake Erie shore erosion, Ashtabula County, Ohio: setting, processes, and recession rates from 1876 to 1973: Ohio Division of Geological Survey Report of Investigations No. 122, 107 p.	Historic look at shoreline erosion rate and shoreline changes.	A scientific analysis that could be useful for future shoreline development projects.
Water Quality	Detroit River- Western Lake Erie Basin Indicator Project	Will compile and analyze existing data on various indicators of ecosystem status, quality and trends and factors that affect them. Will also clearly communicate their findings for policy makers and gaps in ecosystem data.	Recommendations not developed.

Table 4-3. Water quality past, ongoing studies and data gaps.

WLEB Resource Category	Name	Description	Recommendations
Water Quality	Extent of Hypoxia in Nearshore Areas of Lake Erie's Central Basin (Ohio Sea Grant – Ohio Lake Erie Commission)	Measure shoreward intrusions of oxygen-depleted bottom water into shallow regions of the central basin during the period of summer thermal stratification.	Information is expected to help explain the absence of Hexagenia mayflies, zebra and quagga mussels (Dreissenidae), and various other "clean-water" invertebrates from most shallow sedimentary areas of the basin.
Water Quality	Forecasting the Causes, Consequences, and Potential Solutions for Hypoxia in Lake Erie (NOAA)	Develop, test, and apply models to forecast how anthropogenic (land use, invasive species) and natural (climatic variability) stresses influence hypoxia formation and ecology in Lake Erie, with emphasis on fish production potential. Partners include University of Michigan, NOAA's Great Lakes Environmental Research Laboratory, and others.	Develop and use models to assess anthropogenic impacts on Maumee Bay.

4.7 Findings

Maumee Bay is impacted by a variety of water quality issues. Decreased clarity and dissolved oxygen levels, along with the presence of harmful algal blooms, result from high nutrient and sediment loads to the Bay. These water quality issues have an impact on ecological health, recreational uses and commercial navigation. Integrated management of pollution sources and a better understanding of the science behind the water quality problems are needed to develop effective mitigation measures.

Water quality conditions in Maumee Bay are defined and determined by the watersheds draining to the Bay, the open waters of Lake Erie, and the unique physical characteristics of the Bay itself. The watersheds draining to Maumee Bay include large urban areas and agricultural lands that export nutrients and sediments to the Bay. Lake Erie is impacted by invasive species delivered by commercial seagoing vessels, atmospheric deposition and heavy industrial use along other portions of the lake. Maumee Bay's own unique characteristics are significant as well: it is the shallowest portion of Lake Erie and receives a large sediment load from the Maumee River.



Solutions to the water quality problems of Maumee Bay will require coordinated actions at local, regional, national and international levels of government. Reduction of nonpoint sources of nutrients, sediment, bacteria and other pollutants will also require the cooperation of individual land owners and local program coordinators. Reducing loads from waste treatment facilities and legacy contamination may require changes in how federal and state regulations are enforced. Preventing the introduction and spread of invasive species will require public/private sector cooperation at all levels as well, and on a geographic scale that goes well beyond the confines of Maumee Bay or the Great Lakes Basin.

4.8 Potential Actions

Table 4-4 identifies potential actions needed to restore water quality in Maumee Bay. This list warrants consideration by the WLEB Partnership as potential actions are prioritized.

Table 4-4. Water quality potential actions.

Description:	Potential Sponsors	Costs Estimates	Time Frame
Reduce/eliminate impacts of CSOs and SSOs.	City of Toledo	\$0	2008-10 yr
Promote precision application of fertilizer/ manure to reduce excess nitrate runoff.	County SWCD	\$0	2010-2014
Develop comprehensive nutrient management plans for all livestock farms that are not regulated by EPA/Ohio Dept of Agriculture.	NRCS	\$0	2010-2014
Provide agricultural BMP incentives to reduce sediment and nutrient transport to streams.	NRCS	\$0	2010-2014
An extension of a roadway into the Bay near Point Place is negatively impacting circulation. Removal or cut through should be evaluated.	ODOT	\$50,000	2012
Study the thermal impacts of the two Power plants (Consumers and Bay Shore), and the impacts of the fish kills on the fish populations from the kills at the Bayshore/First Energy and Consumers Whiting and DTE in Monroe should be reviewed.	OEPA	\$50,000	2010-2012
Water Quality Dynamics in the Western Basin of Lake Erie and Maumee Bay and Western Lake Erie Water Quality Monitoring.	University of Toledo	\$750,000	2010-2014
Investigation into nutrients (including phosphorous and nitrates) and lyngbya and other forms of algae.	USEPA	\$50,000	2010
Prepare watershed action plan to establish restoration priorities, funding sources and schedule.	Watershed Groups	\$0	2010

5. RESOURCE-BASED RECREATION

5.1 Introduction

Maumee Bay is a focal point for resource- based recreation within the Western Lake Erie Basin, and is critical to the quality of life of residents and visitors alike. Resource- based recreation can generally be defined as parkland, open space and water- based activities such as fishing, hunting, boating, canoeing, hiking and various other forms of outdoor activity. Numerous agencies play an active role in managing the open waters of Maumee Bay and recreation- oriented its areas along coast. ODNR maintains all state parks in the Bay area, with other parkland maintained by federal agencies (e.g., USFWS management of the Cedar Point National Wildlife Refuge)) and sub-state entities such as county park districts, regional districts (e.g., Toledo Metropolitan Park District) and local governments (e.g., Oregon and Toledo). Other recreational open space areas along the coast or near the Bay are maintained by non-governmental entities such as The Nature Conservancy, which owns the 2,200 acre Erie Marsh Preserve.

5.2 Resource-based Recreation: Supply and Demand

Maumee Bay's open water and coastal parks provides substantial opportunity for resource based recreation. Two large game/refuge areas are located in the western basin. The Erie Marsh State Game Area (includes Woodtick Peninsula) is located in Michigan in the vicinity of North Maumee Bay. The Cedar Point National Wildlife Refuge is located just southeast of Maumee Bay and Cedar Point. Carland Beach is located just north of Dry Tree Point. Cullen Park, Detwiler Park, Bayview Park and Maumee Bay State Park are located along the southern shore of Maumee Bay. These parks provide a number of activities including beaches, hiking/biking trails, picnic areas, fishing and boating access, and golf courses (USACE, 2002).

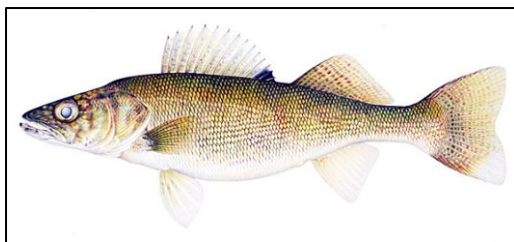


Figure 5-1 Walleye, a common and popular Lake Erie sport fish.

Fishing in Maumee Bay is a popular activity from both shore side and open water locations. A variety of sport fish species inhabit the Bay, and walleye fishing is particularly important from a recreational and local economic standpoint. The spring walleye run in the Maumee River attracts thousands of anglers to river- side communities on an annual basis, with estimates of 6,000 anglers crowding the spawning area near Perrysburg and Maumee.

Recreational boating is a significant activity in Maumee Bay and the Toledo Harbor vicinity. Numerous marinas and associated facilities are located along North Maumee Bay, the Ottawa River, the Maumee River (Toledo Harbor) and other protected areas. Marinas provide seasonal dockage and storage, launch ramps, transient docking, hull and engine repair and services, fuel, ice and water, electricity, sewage pump-out, marine supplies and associated upland facilities (e.g., parking, restrooms, restaurants, fish cleaning stations.) In addition, numerous charter-fishing operations also operate out of the Bay area. Since the Bay is very shallow, adequate maintenance of federal and local navigation channels is a critical concern, particularly to larger

recreational vessels and those with deep draft fixed-keels. Demand for water-oriented recreational facilities continues to grow. This may be attributed to several factors, including evolving community preferences, improved water quality and increased income and leisure time (USACE, 2002).

5.3 Existing Conditions: Problems and Concerns

Opportunities for water-based recreation on Maumee Bay depend upon the ability to access the bay via boat launches, marina facilities and public access sites. In the Ottawa River and Maumee Bay area, upstream of the Summit Street Bridge, private residences with docks line

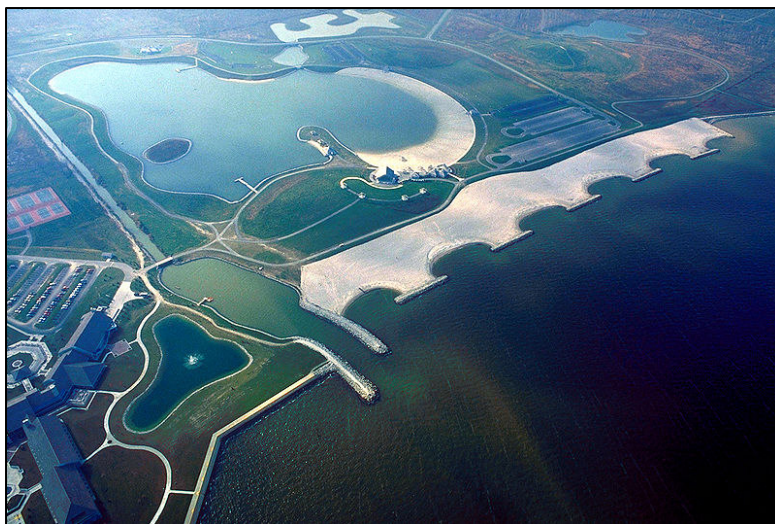


Figure 5-2 Aerial photograph of Maumee Bay State Park.

the Ottawa River shoreline. Downstream of the bridge, numerous marinas and yacht clubs are located along the river. There are no existing public boat ramp sites along the Ottawa River. Along Halfway Creek and Hooper Run, numerous marinas and private residences with private docks line the shoreline. The Michigan Department of Natural Resources boat ramp is located along the north bank of Halfway Creek. Several boat ramp sites are located along Hooper Run.

Marinas provide seasonal dockage and storage, launch ramps, transient docking, hull and engine repair and services, fuel, ice and water, electricity, sewage pump-out, marine supplies and associated upland facilities (e.g., parking, restrooms, restaurants, fish cleaning stations.) Thousands of boats operate out of the Maumee Bay area as do numerous charter-fishing operations.

5.4 Anticipated Conditions: Opportunities and Unmet Needs

Comprehensive planning for recreation and open space has taken place for many of the recreational areas within the watershed. Increasing open space and access to Maumee Bay, as well as improving areas and programs already in existence, is critical to sustaining recreational activity within the watershed. Improvements to both water quality and habitat will also positively impact recreational uses in Maumee Bay and along the shore.

Expansion and protection of the parks along the Maumee River could protect critical shoreline habitat and coastal wetlands by being placed in conservation easement areas, wetland reserve program or the CREP program.

Table 5-1. Resource- based problems, needs and opportunities for Maumee Bay.

WLEB Resource Category	Name	Description	Political Subdivision
Resource- based Recreation	Riverside Trail	This planned trail from downtown Toledo to the north side of Maumee along the west side of the Maumee River	Toledo
Resource- based Recreation	Access/ boat ramps	Access is limited to the River and Bay	ODNR and MDNR

5.5 Past/ Ongoing Studies and Data Gaps

Table 5-2. Recreation past, ongoing studies and data gaps.

WLEB Resource Category	Name of Report	Description	Recommendations
Resource-based Recreation	Estimating the spatial and Temporal Benefits of Recreational Boating and Angling in the Lake Erie Basin	Calculates economic impacts of boating and angling within a season across a geographic location.	Provides useful data related to the economic benefits of recreational boating.
Resource-based Recreation	The economic importance of Nature Based Tourism in Ohio's Lake Erie Tourism Industry	Birding, or bird watching, and other non-consumptive activities have become important components of the recreational activities. It is important that local policy makers understand these changes to maintain the attraction of the coastal area to recreational visitors.	Provides data related to the economic benefits of non-consumptive recreational activities.
Resource-based Recreation	A Comparison of Recreation and Amenity Values in the Lake Erie Basin	Assess amenities that different user groups value along Lake Erie's coastal areas.	Provides data and analysis of which amenities are sought after by different user groups.
Resource-based Recreation	Valuing Great Lakes Beach Recreation: An Economic Assessment of the Recreational Value of Freshwater Beaches	Survey beach users and beach amenities along Ohio's Lake Erie shoreline to determine both the economic value of beach recreation as well as the economic value of specific amenities associated with those beaches.	Reports economic value of beach users.

Table 5-2. Recreation past, ongoing studies and data gaps.

WLEB Resource Category	Name of Report	Description	Recommendations
Resource-based Recreation	The Role of Fishing and the Zebra Mussel on the Tourism Industry	There has been substantial investment in residential dwellings (cottages, condominiums, etc.) which suggests that tourism has become much less dependent on the Lake Erie fishery. A test of the dependence of tourism on the fishery and of the potential damage of the zebra mussel to tourism is critical to policy decisions.	Explores how tourism may be affected by zebra mussels.
Resource-based Recreation	Linking individual decisions and aggregate outcomes to assess potential demands for lake-based recreation and tourism in the Lake Erie region	Lake Erie and its "ecosystem services," such as fish stocks and water quality, provide vital opportunities for recreation and tourism in and around the lake. However, the ways in which household recreation and tourism decisions depend on the health of the lake itself and the processes by which households make such choices are not well understood.	Evaluates how fishery and water quality health impact tourism spending.

5.6 Findings

The relationship between resource-based recreation and the water quality and fishery of Lake Erie/ Maumee Bay is recognized as an important one, yet quantifying this linkage is an active area of research. Developing economic models that relate the resource based recreation industry to the condition of Lake Erie will be useful tools for evaluating the benefits of improving water quality and habitats.

5.7 Potential Actions

Table 5-3. Resource based recreation potential actions.

Description:	Potential Sponsors	Costs Estimates	Time Frame
Construct new boat access and mooring facilities.	ODNR	\$100,000	2012
Quantify the relationship and connection between tourism and water quality and ecological functioning to assess how future dollars are spent.	Ohio State Parks	\$75,000	2011-2014

6. FISH AND WILDLIFE HABITAT

6.1 Introduction

This section of the assessment provides an overview of fish and wildlife habitat resources in Maumee Bay.

6.2 Fish and Wildlife Characteristics

Section 7(c) of the Endangered Species Act of 1973 (16 USC 1531 et seq.) requires that the potential impacts to rare, threatened and endangered species of flora and fauna and their critical habitats be identified to avoid adverse impacts to these species. Federally protected species under the ESA found within the Maumee Bay are listed in Table 6-1.

Table 6.1. Threatened and Endangered Species in Lake Erie.

Species	Status ¹	Habitat	Habitat within Maumee Bay? (yes/no)
<i>Acipenser fulvescens</i> Lake Sturgeon	T	Shallow areas of large lakes	Yes
<i>Coregonus nigripinnis</i> Blackfin Cisco	T (presumed extirpated)	Depths of the Great Lakes	No
<i>Moxostoma carinatum</i> River Redhorse	T	Great Lakes, littoral, benthic	Yes
<i>Opsopoeodus emiliae</i> Pugnose Minnow	E	Great Lakes, littoral, midwater	Yes
<i>Percina shumardi</i> River Darter	E	Great Lakes, littoral, benthic	Yes
<i>Sander canadensis</i> Sauger	T	Great Lakes, pelagic, midwater	Yes

6.3 Existing Conditions: Problems and Concerns

Aquatics (Plankton) and Benthos

Aquatic areas in the WLEB are utilized as habitat by a variety of plankton that fills a critical niche in the food chain of the bay's ecosystem. Such organisms may consist of floating or weakly swimming plant and animal life that are often microscopic in size. Herdendorf's (1987) biological report on western Lake Erie identifies some of the common plankton and epiphytes

¹ T - Threatened, E - Endangered, C - Candidate

(organisms that live on the surface of plants) present, such as algae, protozoans and zooplankton.

Aquatic Vegetation

The littoral zone of Maumee Bay contains a number of submerged aquatic macrophyte beds. The USFWS Coordination Act Report (USFWS 1987 for USACE, 1990) states that, during an aerial survey of the Bay and lower Maumee River, a number of submerged aquatic plant beds were observed. Although aquatic beds are not unique to the bay locale, "they are a part of a habitat type that is relatively scarce in the area".

Fisheries

Both Maumee Bay and the Maumee River provide spawning and/or nursery habitat for a number of the above- mentioned fish species and, in particular, for forage fish such as gizzard shad (USFWS, 1987). In addition to walleye, other fish species in Maumee Bay with sport and/or commercial value include yellow perch, white bass, freshwater drum, channel catfish and white perch.

Wetlands

Coastal/ shoreline areas of Maumee Bay and the lower Maumee River feature a number of lacustrine and palustrine wetland types. Emergent wetlands are present in the general vicinity of Cedar Point (Cedar Point National Wildlife Refuge) and the Woodtick Peninsula, as well as to some degree (i.e., incidentally/and periodically) within harbor CDFs. USFWS Wetland Inventory Maps show about 14 classification types for wetlands in the general vicinity of the bay and lower portion of the river.

Herdendorf (1987) observes that several plant species growing in Maumee Bay marshes (i.e., narrow broad-leaved cattail, jewelweed, blue joint grass, swamp milkweed, swamp rose mallow, soft-stem bulrush, three-square bulrush) dominate the transition zone between the cattail and open waters of the bay.

Wildlife

Herdendorf (1987) notes that large numbers of waterfowl are attracted to coastal marshes along Maumee Bay during migration periods. Spring migration starts around late February and lasts into May, whereas the fall migration peaks into the months of September and October. The WLEB has also been identified by the USFWS as a primary waterfowl migration or wintering area, and its coastal marshes as primary nesting and migration habitat. Many of the waterfowl in the area are diving ducks (e.g. scaup, goldeneye, merganser, ruddy ducks). Dabbling ducks (e.g., mallards, black ducks, widgeon, gadwall, teal) also use this area, but in more limited numbers. Maumee Bay provides a relatively shallow littoral feeding area for waterfowl. Also, resting areas are available in the bay in the lee of small islands, such as in the vicinity of Island 18 (Grassy Island) and along the harbor CDFs. (USACE-Buffalo, 2002).

Avian species typical of shoreline areas (including CDFs) of Maumee Bay include gulls (mainly herring), great blue herons, black-crowned night herons, and neo-tropical songbirds during migration periods and the summer. CDFs also provide resting, feeding and nesting habitat for various aquatic bird and songbird species, including diving and dabbling ducks,



gulls, terns and sandpipers. In order to minimize impacts to colonial nesting birds in the CDFs, to the maximum extent practicable, construction activities within the CDFs are typically scheduled to occur after mid-July. (USACE-Buffalo, 2002).

Woodtick Peninsula and the Cedar Point Wildlife Refuge have been identified by USFWS as attractive sites for large populations of migrating birds due to their geographical location and unique physical and vegetation characteristics. The Woodtick Peninsula is a passerine bird and hawk migration site, while the Cedar Point National Wildlife Refuge has an important wetland complex that provides food and cover for migrating aquatic birds (i.e., waterfowl, shorebirds) as well as habitat for passerines. (USACE-Buffalo, 2002).

Threatened and Endangered Species.

The USFWS listing of Federally Endangered (E), Threatened (T), and Candidate (C) Species in Ohio (May 1, 2006) includes the Indiana Bat (*Myotis sodalis*) (E), all counties; Piping Plover (*Charadrius melodus*) (E), including Lucas County; Ruffed Grouse (*Villosa fabalis*) (C), including Lucas County; Karner Blue Butterfly (*Lycaeides melissa samuelis*) (E), including Lucas County; Eastern Prairie Fringed Orchid (*Plantanthera leucophaea*) (T), including Lucas County; and Eastern Massasauga (*Sistrurus catenatus*) (C), including Lucas County; relative to Lucas and Wood Counties.

Although the American bald eagle was removed from the endangered species list in August 2007, the species is still protected under the Bald and Golden Eagle Protection Act. Since this bird is known to nest at the nearby Ottawa National Wildlife Refuge, it is possible that it also utilizes the shoreline and littoral zone of Maumee Bay for nesting and as a forage area.

6.4 Anticipated Conditions: Opportunities and Unmet Needs

One of the major problems within the Maumee Bay is the need for additional funding for habitat enhancement programs and staff to implement new programs and keep current programs moving forward. There also exists a need to consolidate and prioritize habitat projects within the Bay to maximize use of available resources.

6.5 Past/ Ongoing Studies and Data Gaps

Numerous studies have been completed within the Maumee Bay area. The USACOE, USEPA, Ohio EPA, Ohio DNR and the Maumee RAP have conducted studies on Maumee Bay, with additional studies in process or anticipated. The watershed currently lacks a comprehensive biological inventory of aquatic life. These and other studies/ data gaps are presented in Table 6-3.

Table 6-3: Fish and wildlife habitat past, ongoing studies and data gaps.

WLEB Resource Category	Name	Description	Recommendations
Fish and Wildlife Habitat	Sandusky River/Bay walleye movement and spawning habitat study	Sandusky River/Bay spawning stock movement will be monitored during spawning to determine, among other things, location and use of available spawning habitat within the bay and river.	
Fish and Wildlife Habitat	Evidence of walleye spawning in Maumee Bay, Lake Erie	Study investigated the possibility of walleye spawning during the mid 1990s.	Evidence of walleye spawning was found
Fish and Wildlife Habitat	Detroit River-Western Lake Erie Indicator Studies	Includes data and analysis on several indicators relevant to fish and wildlife habitat.	Use indicators to assess trends and changes.
Fish and Wildlife Habitat	Lake Erie Coastal Management Program Documents	Outlines the projects completed by the Ohio Lake Erie Coastal program.	Describes where improvements could occur.

6.6 Findings

Lake Erie and Maumee Bay have been impacted by several factors that adversely affect fish and wildlife habitat, including declining water quality and invasive species. In some areas, (e.g., walleye spawning success and overall fishery) improvements in recent years have been significant. Conversely, the re-emergence of hypoxia in the WLEB is of growing concern and could adversely affect the fishery. Coastal habitat also is under pressure from development, and measures to protect and preserve natural areas must be evaluated and pursued in light of the benefits such areas provide for resource-based recreation, tourism and the local economy.

6.7 Potential Actions

Primary leads for many fish and wildlife enhancement projects will be local and regional entities (e.g., Partners for Clean Streams/ Maumee RAP, TMACOG, Toledo Metroparks, Wood County Park Board) as well as private organizations (e.g., TNC, Ducks Unlimited, The Joyce Foundation). Partnerships with relevant state and federal agencies (e.g., ODNR, NRCS, USACE) will be instrumental in leveraging both funding and expertise. Potential actions are presented in Table 6-4.

Table 6-4. Fish and habitat potential actions.

Description:	Potential Sponsors	Costs Estimates	Time Frame
Conduct an assessment of Woodtick Peninsula and the Erie March Preserve including the potential use of geotubes to protect the area from further erosion.	ODNR	\$50,000	2011



Table 6-4. Fish and habitat potential actions.

Description:	Potential Sponsors	Costs Estimates	Time Frame
RSM Demonstration	USACE	\$650,000	2010-2011
Develop and apply computer models to assess water quality and ecological impacts of pollutant loadings and invasive species.	USEPA	\$75,000	2013



7. COMMERCIAL AND RECREATIONAL NAVIGATION

7.1 Introduction

Maumee Bay is used extensively for commercial navigation and recreational boating, as serves as the entry point to Toledo Harbor from the open lake. Toledo Harbor is a major port on the Great Lakes- St. Lawrence River system and the seventh busiest in 2006 when it handled over 11 million tons of cargo. The port typically records over 700 commercial vessel transits per year, with vessels ranging in length from 600 feet (class 5 vessels) to 1,000 feet (Class 10 vessels.)

In addition to commercial vessel traffic, recreational craft also make extensive use of Maumee Bay and Lake Erie for activities such as fishing, sight seeing and cruising. Numerous marinas are located within the bay, including at Luna Pier, the Ottawa River, and the Maumee River.

7.2 Navigation Characteristics

Thirty-five piers, wharves and docks are located within Maumee Bay (USACE *Port Of Toledo, Port Series No 44, Revised 2000.*) Seven facilities are located on the bay east of the mouth of the Maumee River; 13 are along the right bank of the lower seven miles of the river; and 15 are located along the left bank of the river. Many of the piers and wharves are used for multiple purposes.

Three commodities (i.e., iron ore, coal, grain) have historically dominated commercial navigation activity at Toledo Harbor. Table 7-1 presents data on tons of each from 1996 through 2005.

Table 7-1. Principal commodities handled at Toledo Harbor.

Year	Iron Ore (S/T)	Coal (S/T)	Grain (S/T) ¹	All Others (S/T)	Total (S/T)
1996	4,281	4,797	2,008	1,946	13,032
1997	4,280	6,931	1,283	1,928	14,422
1998	3,928	5,518	1,779	2,004	13,229
1999	3,101	5,088	1,673	2,465	12,327
2000	2,879	5,521	1,950	2,972	13,322
2001	2,033	4,364	1,898	2,240	10,535
2002	3,020	4,466	1,162	2,467	11,115
2003	2,886	3,519	1,359	2,100	9,864
2004	3,000	2,792	1,620	2,450	9,862
2005	3,889	3,201	1,156	2,258	10,504
10 yr Avg	3,330	4,620	1,589	2,283	11,821

(1) Grain includes soybeans, which is a legume.



Overall, traffic at Toledo Harbor was relatively stable from 1996 through 2000. Traffic then declined to 9,862,000 by 2004. Harbor tonnage in 2005 was 10,504,000. The decline from 2000 through 2004 reflects the sharp decline in the US national economy which started in 2001, and continued through 2004. An examination of data for each of the three principal commodities is helpful in determining future waterborne traffic at the harbor.

Iron ore received at Toledo Harbor come from U.S. and Canadian sources. Iron ore from the U.S. originates primarily from Silver Bay, Minnesota with some originating from Duluth, Minnesota. Iron ore received at Toledo Harbor from Canada originates from harbors on the North Shore of the St. Lawrence River in the Province of Quebec, Canada. The iron ore is received at the lakefront Pellet Terminal facility located near the mouth of the Maumee River. The facility is owned by CSX and operated by the Toledo Ore Railroad Company (TORCO). It transfers iron ore arriving by self unloading vessels (up to 1,000 foot long) to rail cars bound for inland steel mills. All of the iron ore received at Toledo Harbor is destined for AK Steel's integrated steel mills at Middletown Ohio and Ashland Kentucky

Coal shipped from Toledo is mined in the Pittsburgh Seam in the northern Appalachian Mountains and transported to Toledo by rail (or by barge and rail). It consists of "steam" and "metallurgical" coal. Both are high quality, but for the most part are high sulfur content, bituminous coals. Steam coal is consumed at steam-based electric generating stations, while metallurgical coal is processed into coke in conjunction with steel production at integrated steel mills. Coal shipped from Toledo is typically destined for 22 U.S. or Canadian ports located in Michigan, Ohio, New York and Ontario. The coal shipping docks are located near the mouth of the Maumee River, owned by the Toledo- Lucas County Port Authority and operated by CSX transportation, Inc (CSX).

Grain traffic at Toledo is comprised primarily of wheat, corn and soybeans shipped to Port Cartier in Quebec. Small but significant amounts of grain, principally oats, are received at the harbor from Thunder Bay, Ontario. Grain docks are located approximately six miles up the Maumee River.

As indicated in Table 7-2, Michigan and Ohio have consistently been in the top 10 with regard to registered recreational boats, with the latter exhibiting the seventh largest growth rate over the 1996-2005 period. Maumee Bay is the location for a significant amount of such activity, with major attractions including the numerous shoreline communities (e.g., Toledo, Port Clinton, Marblehead, Catawba, Lakeside, Sandusky, Huron); islands (e.g., the Bass Islands, Kelly's Island); and productive open lake fishery (e.g., walleye.)

Table 7-2. Historical Boat Registration Data –Top 10 States.

2005 Rank	1	2	3	4	5	6	7	8	9	10	
Year	Florida	California	Michigan	Minnesota	Wisconsin	Texas	New York	Carolina	Ohio	Illinois	Total US
2005	973,859	963,758	944,138	853,489	839,198	614,616	508,536	416,763	412,375	380,865	12,942,414
2004	894,884	894,884	944,800	853,573	605,467	616,779	519,066	379,458	414,938	393,856	12,781,476
2003	963,379	963,379	953,554	845,379	610,800	619,088	536,094	380,314	413,048	360,252	12,794,616
2002	896,090	896,090	1,000,337	834,974	619,124	624,390	529,732	383,971	413,276	398,431	12,854,054
2001	957,463	957,463	1,003,947	826,173	575,920	621,244	526,190	382,072	525,658	369,626	12,846,346
2000	904,663	904,663	1,000,049	812,247	573,920	626,761	525,436	383,734	416,796	372,162	12,782,143

Table 7-2. Historical Boat Registration Data –Top 10 States.

2005 Rank	1	2	3	4	5	6	7	8	9	10	
Year	Florida	California	Michigan	Minnesota	Wisconsin	Texas	New York	Carolina	Ohio	Illinois	Total US
1999	955,700	955,700	985,732	793,107	562,786	629,640	524,326	414,527	407,347	372,618	12,738,271
1998	895,132	895,132	980,378	780,097	559,321	625,754	514,749	394,842	407,686	396,945	12,565,930
1997	894,347	894,347	957,105	768,555	543,034	615,438	512,430	376,201	399,888	368,513	12,312,982
1996	861,092	861,092	945,817	758,541	543,305	611,374	458,092	416,085	398,388	366,378	11,877,938
Percent Change in Boat Registrations – 9 Year Period											
2005-1996	29.97%	11.92%	-0.18%	12.52%	17.65%	0.53%	11.01%	0.16%	3.51%	3.95%	8.96%
Number of New Boat Registration Per Year - By 9 Year Period											
2005-1996	24,948	11,407	(187)	10,550	10,655	360	5,605	75	1,554	1,610	118,275

As noted by the registration data in Table 7-3, Lake Erie shoreline counties consistently have the largest number of registered boats in the state of Ohio, with Lucas County being the seventh highest in the state. An estimated one third of the state's boating activities take place on Lake Erie, with the WLEB a principal destination. A 1998 statewide survey revealed that 11% of respondents named Ottawa County as their most frequent boating destination, followed by Erie County (4% of respondents).

Table 7-3. State Of Ohio Top 10 Counties in Boat Registrations.

Rank	Country	2000	2001	2002	2003	2004	2005	2006	2007
1	Franklin	28,364	27,810	27,559	27,373	26,263	25,939	26,088	26,376
2	Cuyahoga	27,705	27,290	26,972	26,598	25,617	24,966	24,748	24,391
3	Summit	20,641	20,135	20,174	20,120	19,719	19,484	19,382	19,356
4	Hamilton	19,702	19,350	18,857	18,947	18,138	17,737	17,787	17,903
5	Montgomery	17,461	16,905	16,697	16,538	16,034	15,739	15,725	15,512
6	Stark	15,651	15,674	15,458	15,360	14,847	14,647	14,527	14,516
7	Lucas	15,445	15,025	14,856	14,867	14,358	13,858	13,917	13,712
8	Butler	11,144	11,086	10,860	11,125	11,283	11,298	11,139	11,144
9	Lorain	9,875	9,587	10,118	10,272	10,279	10,238	10,516	10,655
10	Lake	9,095	9,083	9,312	9,202	8,924	8,885	8,938	9,054

7.3 Navigation Infrastructure, Programs and Best Management Practices

The two Federal channels at Toledo Harbor (i.e., Lake Approach Channel, Maumee River Channel) are maintained by USACE, along with three turning basins. The Lake Approach Channel extends from the mouth of the Maumee River into Lake Erie for about 18 miles to deep water. The Lake Approach channel is 28 feet deep and 500 feet wide. The Maumee River Channel starts at the mouth of the river and extends a distance of approximately seven miles. With the exception of a widening of the Federal channel at the mouth of the river, the river channel has a width of 400 feet. The center 200 feet of the river has an authorized depth of 27

feet, with the remainder having an authorized depth of 25 feet. All channel depths are measured from LWD.

On average, 845,000 cubic yards of in situ material have been removed annually from 1999-2003. Approximately 35% of this material is placed in CDFs, with the remainder disposed of in the current open-lake placement site (a two square-mile area) located north of the lake navigation channel, about 12 miles northeast of Toledo Harbor.

CDF sites at Toledo Harbor include Grassy Island 18 and Facility 3. Grassy Island is approximately 132 acres and is located just northeast of the mouth of the river. Facility 3 is located southeast of the mouth of the river and consists of Cell 1 (approximately 242 acres); Cell 2 (approximately 55 acres); and Cell 3 (approximately 90 acres.) Island 18 (federal) was used for disposal of dredged material from federal navigation channels determined to be not suitable for open-lake disposal from 1962 through 1977. Facility 3 Cell 1 (federal) was used from 1978 through 1995. Facility 3 Cell 2 (federal) was used from 1996 through the present.



Figure 7- 1. Toledo Harbor confined disposal facility locations.

Best Management Practices are currently being applied to Facility 3 as well as Island 18. This includes practices that foster dewatering and consolidation (i.e., contouring within the CDF as well as trenching) as well as measures that extend the useful life of the facilities (i.e., regrading of in-place soils to obtain additional disposal space.).

Maintenance dredging of the Toledo Harbor federal channels (entrance channels and the Maumee River) provides access channels that are more than adequate for use by recreational boaters. The various marinas and public facilities located in the Maumee Bay area are responsible for any dredging needs that arise within their own facilities.

7.4 Existing Conditions: Problems and Concerns

Information gathered from vessel operators currently servicing Toledo Harbor indicate concerns with the current alignment of the federal channels; problem areas include the mouth of the Maumee River and the upper end of commercial navigation near the Conrail Swing Bridge located just north of the Anderson grain elevators. The current channel alignments do not allow vessels to line up properly to navigate through these areas. Thus, vessels incur additional maneuvering time to transit these areas safely. In addition, the current channel location at the mouth of the Maumee River is prone to siltation. A realignment of this channel could potentially reduce dredging needs in this area, as well as provide a better approach channel to the harbor for commercial vessel traffic.

With respect to recreational boating, the economic impact of recreational boating on Ohio's economy has been placed at \$1.4 billion annually in direct and indirect impacts. Further, recreational boater expenditures supported 19,500 jobs in the state. Recognizing this, Ohio has a number of initiatives underway to promote recreational boating on Lake Erie. The ODNR *"Boating On Ohio's Water Ways Plan"* (May 2004) identifies eight prioritized strategies, the first three of which address recreational boating. Through the use of focus groups, the study identified various boater needs related to Lake Erie usage, including a need for additional transient boater facilities on the lake. Transient boating generally takes place in groups, and a need exists for facilities that have adequate depths, short term rental dockage, nearby restaurants and available land-based transport. Staying at a transient or short term rental dock was preferred by most boaters (73%) that took an overnight boat trip on Lake Erie, as opposed to tying up along shore or anchoring in open water.

A transient boat dock objective was added in 2003 to the Lake Erie Quality Index (LEQI), calling for full service transient dockage by 2010 (at market rates) at least every 15-25 miles along Ohio's Lake Erie shoreline. Use of the federal Boating Infrastructure Grant Program (initiated in 1998 through a federal excise tax on fishing equipment and motorboat fuels) was suggested as the preferred mechanism to attain this objective.

7.5 Anticipated Conditions: Opportunities and Unmet Needs

Given its strategic location and infrastructure, Toledo is expected to remain a major commercial port on the Great Lakes- St. Lawrence system. To remain competitive, however, modifications to existing channel alignments to reduce vessel transit times and/ or dredging needs should be pursued.

As noted earlier, the 2004 *"Boating On Ohio's Water Ways Plan"* identified the lack of transient slips as a primary problem for the recreational boating community. A preliminary estimate of the number of slips (seasonal and transient) available in Maumee Bay area and the Maumee River is presented in Table 7-4, with data based upon an Ohio Sea Grant publication, (2006 *Western Lake Erie Guide To Marinas*) and an ODNR publication (*Ohio Boat Access Sites*.) As noted, 3,862 slips were identified in public and private marinas, of which only 164 are set aside for transient usage. Approximately half of these transient slips are located on the



Maumee River. Forecasted increases in recreational boating activity, including overnight boat trips, suggests a need to provide additional transient slips.

7.6 Past/ Ongoing Studies and Data Gaps

A USACE Section 905B study (authorized in 1996 by U.S. House Resolution 2496) investigated the need for channel and turning basin improvements at the upstream end of the existing commercial Federal navigation channels. The report was completed in 1998.

As noted earlier, ODNR produced *“Boating on Ohio’s Waterways Plan, a Strategic Plan for Ohio Boating”* in 2004. The plan identified the need for additional transient dockage facilities as a primary concern of the recreational boating community.

The City of Toledo has been pursuing development of a Marina District since 2000 and is currently still working on the project as of May 2008. A 125 acre site has been selected, located on the east bank of the Maumee River bounded by Front Street, Main Street, and I-280. The environmental cleanup of the site is complete, making it ready for construction. The \$320 million development project would help revitalize the east Toledo waterfront of the Maumee River across from Toledo’s downtown area. Plans call for quality waterfront housing and a marina with boat slips that would eventually attract retailers and boaters from Toledo and surrounding Great Lakes communities. Potential components of the marina district could include housing, an amphitheater, an ice rink complex, future entertainment, retail space, a bike-and-walking path along the river's edge as well as a marina and passenger terminal. The latter would potentially provide passenger ferry service for passengers to and from Sandusky, Lake Erie island ports, possibly Detroit, and Canadian ports such as Windsor, Ontario. The terminal would be multi functional, and capable of handling fast ferries, Great Lakes cruise vessels, visiting tall ships, water taxis and local tour vessels.



Table 7-4. Slip Availability- Maumee Bay, Maumee River Area.

Marinas	Seasonal Slips	Transient Docks	Total
Otter Creek			
Toledo Beach Marina	588	12	600
North Cape Yacht Club	150		150
	738	12	750
Luna Pier			
Luna Pier Harbor Club	370	30	400
	370	30	400
Ottawa River Vicinity			
State Line Marina	143		143
Jo Jos Marina	57		57
Lost Peninsula Marina	600		600
Bush Marina	88		88
Bush Marina	250		250
Jocketts Marina	80	4	84
Riverview Yacht Club	20		20
Jolly Roger Sailing Club	100		100
Point Place Boat Club	54	3	57
Chets marina	30		30
River Run Marina	6		6
	1,428	7	1,435
Maumee River			
Bayview Yacht Club	163		163
Toledo Yacht Club	111		111
Harrison Marina	305		305
Brenner Marine Docks	36	4	40
Brenner 75 Marina			0
Portside Docks (COS!)		70	70
International park-The Docks			0
Rossford Marina	253		253
Toledo Sailing Club	97	3	100
Maumee River Yacht Club	70		70
Toledo Country Club	20		20
Indian Hill Boat Club	35		35
Perrysburg Boat Club	66		66
Harbor View Yacht Club	168	6	174
	1,324	83	1,407
Maumee Bay			
Maumee Bay Resort Marina	2	32	34
	2	32	34
Total	3,862	164	4,026

7.7 Findings

The 905B study determined that there was a federal interest in making improvements to the federal channel at the head of navigation. The plan called for enlarging the existing turning basin and relocating an authorized but un-built channel located along the east (right bank) side of the Maumee River. Nine different benefit categories were evaluated. Turning basin and channel relocation improvements were evaluated both independently and as a combined plan. Both evaluations yielded benefit to cost ratios of at least 2.1. However, a cost share sponsor for a full feasibility study was never secured.

Two recent major public investments have taken place in the Marina District and will act as catalysts for future growth. A \$5.62 million, 77 slip Glass City Municipal Marina was completed in 2007, partially funded with Boating Infrastructure Grant Program funds. The facility will provide 20 slips dedicated to transient dock usage. The floating dock facility provides electric and water hookups



Figure 7-2. Glass City Municipal Marina and Passenger Terminal.

Adjacent to the marina is a \$3.2 million Glass City Municipal Marine Passenger Terminal, targeted for opening in mid- 2008. The 15,600-square-foot, multi-functional terminal was designed to accommodate fast ferry service, Great Lakes cruise vessels, visiting tall ships and water taxis. The port authority has solicited proposals from potential marine passenger service operators who could offer ferry service to a range of destinations including Detroit, Lake Erie Islands, Cedar Point Amusement Park and/or other destinations or routes that may be proposed.

It will also house the City of Toledo's marina operations, offer banquet and catered events for corporate and public meetings, and offer boating education and safety programs.

7.8 Potential Actions

The Port of Toledo is expected to continue to be a major receiving/ shipping port on the Great Lakes- St. Lawrence system, handling iron ore, coal and grain and providing intermodal connections for these commodities. Short sea shipping opportunities exist for new cargoes, thereby leading to increased port growth. It is important that current federal navigation channels be maintained and aligned to provide safe and efficient transit for commercial vessel operators.

Two areas of the existing federal channels are in need of improvement. One area is at the mouth of the Maumee River and the other area is the upper end of commercial navigation near the Conrail Swing Bridge located just north of the Anderson grain elevators. Realignment of the channels would allow commercial vessels to transit these areas more efficiently, and potentially reduce existing channel dredging needs.

A channel realignment study has been identified in WRDA 2007 (Section 4072) to investigate channel improvements at these two areas. The likely sponsor for the project is the Toledo-Lucas County Port authority. An initial Reconnaissance Evaluation (Section 905 (b) Reconnaissance analysis) is being pursued, at an initial federal cost of \$100,000.

Over 3,800 slips are available for recreational boaters in various marinas throughout Maumee Bay and Maumee River area, with the great majority dedicated to seasonal rentals. Recreational boaters in western Lake Erie have identified a need for transient slips as well. The City of Toledo has addressed some of this need by including 20 slips in its new municipal marina to be set aside for transient usage.

The possibility of using CDFs for recreational, wildlife habitat or other uses should be investigated and discussed in a Master Plan.

Table 6-4. Commercial and Recreational Navigation potential actions.

Description:	Potential Sponsors	Costs Estimates	Time Frame
Construct transient slips.	City and private marinas	\$100,000	2010-2012
Use CDFs for recreational, wildlife habitat and other uses.	ODNR	\$0	2012-2016
Study to evaluate realignment of navigation channel.	Toledo-Lucas County Port Authority	\$100,000	2012
Investigate short sea shipping opportunities.	Toledo-Lucas County Port Authority	\$75,000	2012
Maintenance Dredging, Primary and Backlog.	USACE	\$19,530,000	2009-2011

8. FUTURE WATERSHED CONDITIONS

8.1 Forecast of Future Watershed Conditions

Future conditions associated with the five Study Categories (i.e., flood risk management, water supply, sedimentation and bank erosion; water quality; resource-based recreation; fish and wildlife habitat; commercial and recreational navigation) in the Maumee Bay will (among others) be a function of regional climate conditions and trends, geography of area (flatness), water use demands, rural drainage system management, land use practices (urban and rural), economic development trends (e.g., manufacturing, commercial development, agriculture, transportation), compliance with existing regulations (e.g., MS4, LTCP, NPDES), and recreation trends. Without an investment in restoration of watershed health and reduction of flood hazard risks, it is anticipated that the foreseeable future will find that flood damage will continue; Maumee Bay water quality will decline; fish and wildlife resources will be limited in quantity, quality and biodiversity; resource-based recreation opportunities will not be realized; and commercial and recreational costs will increase, thereby compromising potential economic benefits.

From a water quality perspective, nonpoint pollution will continue given the intensive agricultural activity throughout the WLEB. This will consist of runoff from diffuse sources containing sediments, nutrients, fecal coliform and other contaminants. Where combined sewers are the primary method of managing sanitary waste and collecting stormwater, implementation of the City of Toledo's and other communities Long Term Control Plans, is expected to result in substantial reduction in fecal coliform, nutrients, and pollutants associated with combined sewer overflows over the next 20 to 30 years.

Some improvement in water quality is evident due to past investments in rural conservation practices (reduced sediment loadings and total suspended solids). While it is anticipated that pollutant loadings will continue to vary from year to year depending upon factors such as rainfall amounts, and amount/type of cover crops. Loading trends are likely to continue at levels that will cause both localized water quality degradation in the Lower Maumee and continued problems in Maumee Bay associated with excess nutrient loads (e.g., fertilizers, human waste).

Fish and wildlife habitat resources are likely to be sustained at very low levels due to intensive agricultural land use practices in the rural areas, urbanization, and loss of wetland, riparian, and open space (e.g., woodlands, fields) resources. Wetlands, riparian areas and open spaces provide very important water quality and flood attenuation benefits by filtering, storing and slowing water. Resource-based recreation is threatened due to ongoing problems associated with pollutant loads entering the Bay from the WLEB although localized improvements in water quality associated with the implementation of the City of Toledo's Long Term Control and Stormwater Management Plans are anticipated. These factors combined are likely to continue to dampen recreational fishing and impact the area's ecotourism opportunities although some benefits from these investments can be expected.



Finally, commercial navigation will likely continue to be impacted by sediment loads, and more importantly by continued increased dredging and dredge management costs. Application of conservation practices elsewhere in the WLEB are likely to reduce sediment loads some so overall impacts are likely to be lessened somewhat as a result of these investments. However, dredging costs can be expected to continue to increase, with the potential adverse economic implications for the Port of Toledo's standing as the largest Great Lakes port (by tonnage) and its role in the local/regional economy. Recreational navigation- particularly in the Lower Maumee Watershed and in Maumee Bay is a major activity and economic driver, and heavily reliant upon adequate public access, navigation depths and water quality. Sedimentation problems are expected to have a negative influence on this industry. Energy costs are also expected to dampen demand.

9. PLAN INTEGRATION: RELATIONSHIP TO OTHER WATERSHED PLANS

The Maumee Bay is one of 10 areas included in the Western Lake Erie Basin (WLEB) project. Each watershed/body assessment is unique in that it is based on the input from stakeholders and review of past studies completed or studies underway in the watershed to determine watershed flooding and conservation problems, needs, and opportunities. At the same time, each watershed is part of a larger watershed system, except in the case of the Ottawa and Portage Rivers which drain directly into Lake Erie and Maumee Bay which is part of Lake Erie. Maumee Bay receives drainage from all of the watersheds assessed except for the Portage River watershed.

While there may be problems, needs, and opportunities unique to each watershed assessment area, other problems, needs, and opportunities may be common to the larger WLEB project area. Thus, plan integration is essential to determining local priorities which may take precedent over other watershed assessment priorities and those watershed problems, needs, and opportunities which may cross watershed boundaries and States requiring pooling of resources and implementation of collaborative and programmatic initiatives.



Figure 9-1 Western Lake Erie Basin major watersheds.

The WLEB Partnership under the leadership of the USACE and NRCS will be developing a unified and comprehensive Watershed Management Report based on the findings of the individual watershed assessments. This Report will form the basis for developing a Report to Congress which will include a set of explicit recommended measures for solving both priority local flooding problems and also serve as a blueprint for moving forward in the WLEB. It is anticipated that recommendations may consist of both specific projects and programs to solve priority problems and additional studies needed to fill data and information gaps necessary to build the scientific and engineering basis for additional projects and programs needed to restore watershed health.

10. PLAN IMPLEMENTATION

The 10 watershed assessments associated with this project, as well as the consolidated Report to Congress, will provide guidance to an array of public and non-governmental entities with a role and responsibility for the restoration, protection and sustainable use of the water and related natural resources of the Western Lake Erie Basin. Specific approaches to plan implementation will be a function of 1) the nature of potential actions as prioritized at the individual watershed and Western Lake Erie Basin level; and 2) the requirements and procedures associated with the various prospective sponsors of such actions.

As is evident from this report, the range of potential actions goes well beyond the authority or scope of the Corps of Engineers or any other individual agency/ organization. Leadership (and partnerships) will be required of various federal, state, regional and local governments; academic institutions; foundations; private sector interests; and others with a commitment to the future of the WLEB. Funding sources for implementation will vary as well, and could include a broad range of traditional (e.g., federal, state, and local government funding, foundations) and non-traditional sources (e.g., conservancy districts, utilities, assessments, mitigation banks, in-lieu fees).

At the conclusion of the prioritization process, an Implementation Strategy must be developed (at the Western Lake Erie Basin level) to provide the blueprint needed to harmonize the work of multiple entities, each with distinct project requirements, timeframes and funding sources. A “capital improvements” inventory offering a detailed descriptive listing of recommended projects, costs, sponsors, authorities and related information will be an invaluable component of the Implementation Strategy.

The strategy for securing federal projects will be dictated by the nature of the potential action, and whether that action can be implemented under existing authority or will require authorization by the Congress. Implementation for other projects will be accomplished via partnerships among local, state and federal entities and/or by specific sponsors.



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Appendix A. List of Acronyms

<i>A/E</i>	<i>Architect/Engineer</i>
<i>Am. River</i>	<i>American Rivers Organization</i>
<i>AMP</i>	<i>Ambient Monitoring Program</i>
<i>AR</i>	<i>Army Regulation</i>
<i>ARS USDA</i>	<i>Agricultural Research Service</i>
<i>ASLF</i>	<i>Atlantic States Legal Foundation</i>
<i>BMP</i>	<i>Best Management Practice</i>
<i>CAP</i>	<i>Conservation Action Project</i>
<i>CEFMS</i>	<i>Corps of Engineers Financial Management System</i>
<i>CELRB</i>	<i>Corps of Engineers Lakes and Rivers – Buffalo</i>
<i>CELRBM</i>	<i>Corps of Engineers Lakes and Rivers – Buffalo Memorandum</i>
<i>CELRD</i>	<i>Corps of Engineers Lakes and Rivers Division</i>
<i>CERCLA</i>	<i>Comprehensive Environmental Response, Compensation, and Liability Act</i>
<i>CFR</i>	<i>Code of Federal Regulation</i>
<i>CHRP</i>	<i>Comprehensive Habitat Restoration Plan</i>
<i>CSO</i>	<i>Combined Sewer Overflow</i>
<i>CSS</i>	<i>Combined Sewer System</i>
<i>CW</i>	<i>Civil Works</i>
<i>CWE</i>	<i>Current Working Estimate</i>
<i>CWP</i>	<i>Center for Watershed Protection</i>
<i>CX</i>	<i>Center of Expertise</i>
<i>DDE-PM</i>	<i>Deputy District Engineer for Project Management</i>
<i>DE</i>	<i>District Engineer</i>
<i>DFARS</i>	<i>Defense Federal Acquisition Regulation Supplement</i>
<i>DOD</i>	<i>Department of Defense</i>
<i>DQLL</i>	<i>Design Quality Lessons Learned</i>
<i>DU</i>	<i>Ducks Unlimited</i>
<i>EA</i>	<i>Environmental Assessment</i>
<i>EFARS</i>	<i>Engineer Federal Acquisition Regulation Supplement</i>
<i>EIS</i>	<i>Environmental Impact Statement</i>
<i>EPA</i>	<i>Environmental Protection Agency</i>
<i>ER</i>	<i>Engineer Regulation</i>
<i>Evt. Defense</i>	<i>Environmental Defense, Center for Conservation Initiatives</i>
<i>FAR</i>	<i>Federal Acquisition Regulation</i>
<i>FEMA</i>	<i>Federal Emergency Management Agency</i>
<i>FOIA</i>	<i>Freedom of Information Act</i>
<i>FS</i>	<i>Feasibility Study</i>
<i>FSA USDA</i>	<i>Farm Service Agency</i>
<i>FY</i>	<i>Fiscal Year</i>
<i>GIS</i>	<i>Geographic Information System</i>
<i>HAB</i>	<i>Habitat</i>
<i>HUC</i>	<i>Hydrologic Unit Code</i>
<i>HYG</i>	<i>Hydrogeologic</i>
<i>IDEM</i>	<i>Indiana Dept of Environmental Management</i>

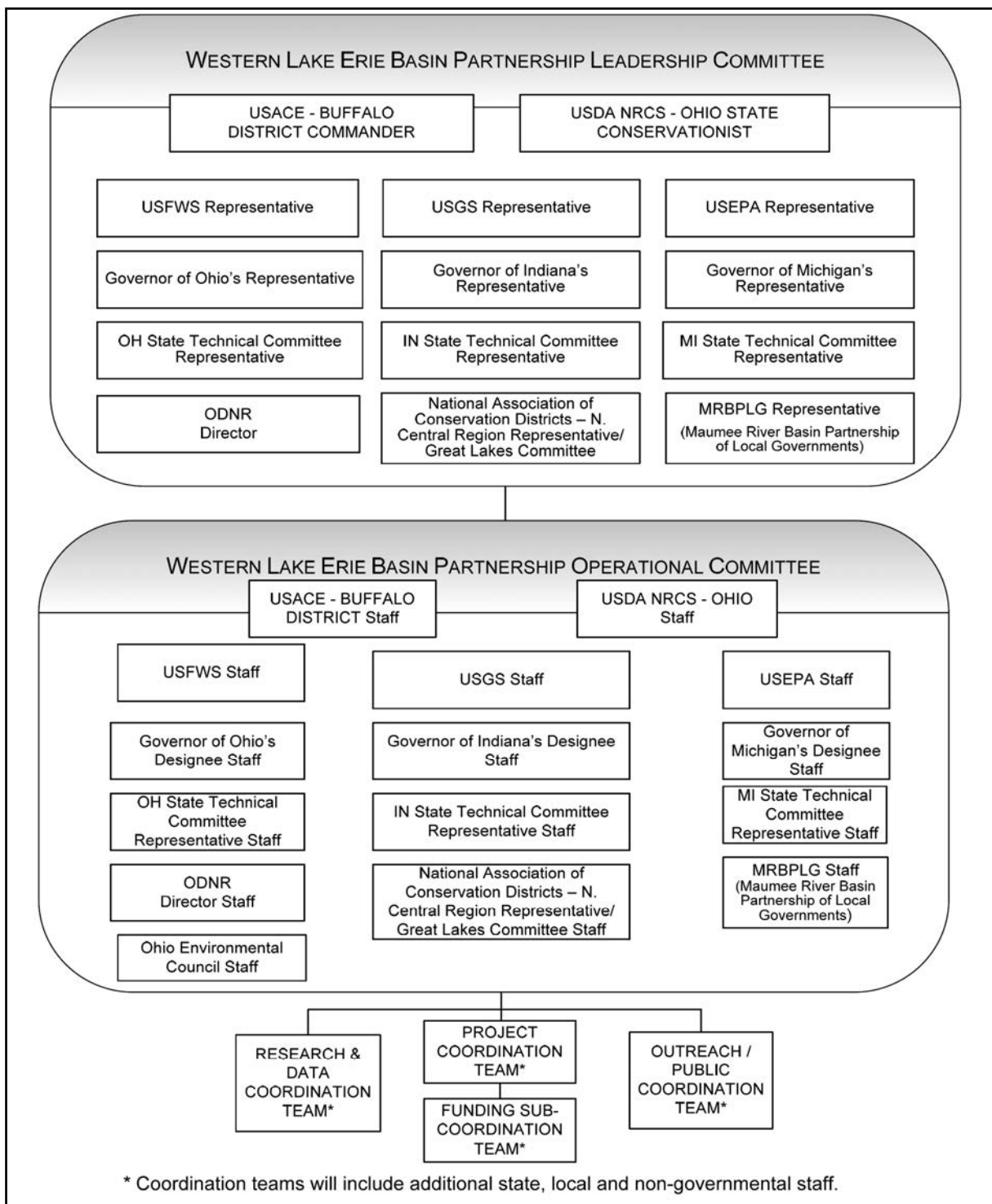


<i>IFG</i>	<i>Inland Fisher Guide</i>
<i>IRM</i>	<i>Interim Remedial Measure</i>
<i>ISDA</i>	<i>Indiana State Dept. of Agriculture</i>
<i>ITR</i>	<i>Independent Technical Review</i>
<i>JOYCE</i>	<i>The Joyce Foundation</i>
<i>MAWI</i>	<i>Multi-scale Assessment of Watershed Integrity</i>
<i>MCP</i>	<i>Management & Coordination</i>
<i>MDA</i>	<i>Michigan Dept. of Agriculture</i>
<i>MDEQ</i>	<i>Michigan Dept. of Environmental Quality</i>
<i>MIPR</i>	<i>Military Inter-agency Purchase Request</i>
<i>MOA</i>	<i>Memorandum of Agreement</i>
<i>MOU</i>	<i>Memorandum of Understanding</i>
<i>MRBPLG</i>	<i>Maumee River Basin Partnership of Local Governments</i>
<i>MVRCD</i>	<i>Maumee Valley Resource Conservation and Development</i>
<i>NACD</i>	<i>National Association of Conservation Districts</i>
<i>NEC</i>	<i>National Economic Council</i>
<i>NEPA</i>	<i>National Environmental Policy Act</i>
<i>NFPA</i>	<i>National Fire Protection Association</i>
<i>NGO</i>	<i>Non Governmental Organizations</i>
<i>NPS</i>	<i>Non-point Source</i>
<i>NRCS USDA</i>	<i>Natural Resources Conservation Service</i>
<i>NRDA</i>	<i>National Resource Damage Assessment</i>
<i>NTP</i>	<i>Notice to Proceed</i>
<i>O&M</i>	<i>Operations & Maintenance</i>
<i>ODA</i>	<i>Ohio Dept. of Agriculture</i>
<i>ODH</i>	<i>Ohio Dept. of Health</i>
<i>ODNR</i>	<i>Ohio Department of Natural Resources</i>
<i>ODNR</i>	<i>Ohio Department Of Natural Resources</i>
<i>ODOD</i>	<i>Ohio Dept. of Development.</i>
<i>ODOT</i>	<i>Ohio Dept. of Transportation</i>
<i>OEC</i>	<i>Ohio Environmental Council</i>
<i>OEPA</i>	<i>Ohio Environmental Protection Agency</i>
<i>OEPA</i>	<i>Ohio Environmental Protection Agency</i>
<i>OLEC</i>	<i>Ohio Lake Erie Commission</i>
<i>OSHA</i>	<i>Occupational Safety and Health Administration</i>
<i>OSU</i>	<i>The Ohio State University</i>
<i>PCB</i>	<i>polychlorinated biphenyl</i>
<i>PDT</i>	<i>Project Delivery Team</i>
<i>PEIS</i>	<i>Programmatic Environmental Impact Statement</i>
<i>PGL</i>	<i>Policy Guidance Letter</i>
<i>PL</i>	<i>Public Law</i>
<i>PLA</i>	<i>Project Labor Agreement</i>
<i>PM</i>	<i>Project Manager</i>
<i>PMBP</i>	<i>Project Management Business Process</i>
<i>PMP</i>	<i>Project Management Plan</i>
<i>POC</i>	<i>Point of Contact</i>



<i>PORT</i>	<i>Toledo Port Authority</i>
<i>PR&C</i>	<i>Purchase Request & Commitment</i>
<i>QCP</i>	<i>Quality Control Plan</i>
<i>RI</i>	<i>Remedial Investigation</i>
<i>RTS</i>	<i>Regional Technical Specialist</i>
<i>SBA</i>	<i>Small Business Administration</i>
<i>SCORP</i>	<i>Statewide Comprehensive Outdoor Recreation Plan</i>
<i>SHPO</i>	<i>State Historic Preservation Office</i>
<i>SJWI</i>	<i>Saint Joe Watershed Initiative</i>
<i>SOP</i>	<i>Standard Operating Procedure</i>
<i>SOW</i>	<i>Scope of Work</i>
<i>SVA</i>	<i>Stream Visual Assessment</i>
<i>SWCD</i>	<i>Soil and Water Conservation District(s)</i>
<i>TMACOG</i>	<i>Toledo Metropolitan Council of Governments</i>
<i>TNC</i>	<i>The Nature Conservancy</i>
<i>USACE</i>	<i>U.S. Army Corps of Engineers</i>
<i>USC</i>	<i>United States Code</i>
<i>USDA</i>	<i>United States Department of Agriculture</i>
<i>USEPA</i>	<i>U.S. Environmental Protection Agency</i>
<i>USFWS</i>	<i>U.S. Fish and Wildlife Service</i>
<i>USGS</i>	<i>U.S. Geological Survey</i>
<i>UT</i>	<i>University of Toledo</i>
<i>VTC</i>	<i>Video Teleconferencing</i>
<i>WAU</i>	<i>Watershed Assessment Unit</i>
<i>WLEBS</i>	<i>Western Lake Erie Basin Study</i>
<i>WRDA</i>	<i>Water Resources Development Act</i>

Appendix B - 1. Organizational Structure of the WLEB Partnership.





Appendix B-2. Roles and Responsibilities of WLEB Partnership.

WLEB Functional Elements	Purpose	Functions
Leadership Committee	<ul style="list-style-type: none"> ➤ Establish and maintain the mission of the Western Lake Erie Basin Partnership. ➤ Set goals, assess performance, and report progress on the watershed improvement effort. ➤ Allocate available resources for Partnership requirements. ➤ Provide ongoing public outreach on the watershed improvement effort. ➤ Provide ongoing senior-level coordination among Partnership member agencies and non-member agencies. 	<ul style="list-style-type: none"> ➤ Review progress, address issues requiring senior level coordination, and resolve issues brought forward by the standing Coordination Teams. ➤ Publish on an annual basis a report on the overall watershed improvement progress and status of the Partnership. The USACE and NRCS shall be responsible for preparing the draft report, coordinating the draft report, and issuing the final report. ➤ The report shall publish watershed improvement requirements, funds status, project progress, outreach activities, leadership decisions, and open issues. The standing Coordination Teams shall provide input for the report. ➤ Sponsor and conduct an annual Partnership Meeting for all Partners, Advisors, Coordinators and Participants. ➤ Review and approve all final actions of the standing Coordination Teams. ➤ Select and approve standing Coordinators who represent interested and involved organizations that sign the member agreement.
Operational Coordination Team	<ul style="list-style-type: none"> ➤ Coordinate the day-to-day activities of the Partnership, prepare for Leadership Committee meetings, and prepare recommendations to the Leadership Committee for evaluation. ➤ At least annually, the Advisors shall evaluate and make recommendations to the Leadership Committee as to whether or not there are additional State, Federal, local agencies, or nongovernmental organizations (NGOs) that can bring additional resources (i.e., funding, people, facilities, material, or equipment) to Partnership activities. 	

Appendix B-2. Roles and Responsibilities of WLEB Partnership.

WLEB Functional Elements	Purpose	Functions
Project Coordination Team	<ul style="list-style-type: none"> ➤ Serve as the Partnership's technical center of expertise on specific projects. ➤ Investigate and provide technical recommendations to the Operational and Leadership Committees as directed. ➤ Provide input for a comprehensive project database and schedule for the entire watershed improvement effort. Monitor projects' program and progress and provide data for status reports showing metrics based progress. ➤ Identify and prioritize projects required for watershed improvement. 	<ul style="list-style-type: none"> ➤ Develop and maintain a comprehensive project database. ➤ Develop and maintain a comprehensive project schedule. ➤ Seek input about potential projects from State, Federal, Local agencies or nongovernmental organizations (NGOs) and identify opportunities for project coordination. ➤ Provide project definition packages to the Funding Sub-Coordination Team. ➤ Make recommendations to the Leadership Committee. ➤ Develop operating procedures to be approved by the Leadership Committee. ➤ Other duties as assigned by the Leadership Committee.
Funding Sub-Coordination Team	<ul style="list-style-type: none"> ➤ Track existing funding (amount and source) for the Partnership and the watershed improvement effort. ➤ Identify and recommend potential funding sources for watershed improvement projects. ➤ Develop a funding strategy for Partnership projects. ➤ Make recommendations to the Project Coordination Team and Operational Committee. 	
Outreach Coordination Team	<ul style="list-style-type: none"> ➤ Enhance public knowledge and understanding of the Partnership and the status of the watershed improvement effort. ➤ Provide a single point of contact for the public to address watershed improvement needs, desires, and issues. 	<ul style="list-style-type: none"> ➤ Develop and maintain the Partnership web site and/or other media to provide continuous updates on the watershed improvement effort. ➤ Identify and pursue opportunities for public participation and education in the watershed improvement effort. ➤ Seek, accept, and coordinate public input and responses, as necessary. ➤ Make recommendations to the Leadership Committee.



Appendix B-2. Roles and Responsibilities of WLEB Partnership.

WLEB Functional Elements	Purpose	Functions
		<ul style="list-style-type: none">➤ Develop operating procedures to be approved by the Leadership Committee.➤ Other duties as assigned by the Leadership Committee.
Research and Data Coordination Team	<ul style="list-style-type: none">➤ Synthesize the existing available data into a format useable for watershed analysis across three States: Indiana, Michigan, and Ohio.➤ Identify gaps in the existing data, prioritize data and research needs, and work within existing authorities and available funding to improve understanding of the Western Lake Erie Basin.	



Appendix B-3. USACE Continuing Authorities Program (CAP).

CAP Authority	Description	Per Project Federal Limit \$ ¹
Aquatic Ecosystem Restoration (Section 206, Water Resources Development Act of 1996)	This provides for planning, design, and construction of aquatic ecosystem restoration and protection projects, when it is found that the project will improve the quality of the environment, is in the public interest and is cost effective.	\$5,000,000
Beach Erosion Control (Section 103, River and Harbor Act of 1962, as amended)	The Corps of Engineers may construct beach restoration and protection projects not specifically authorized by Congress.	\$2,000,000
Ecosystem Restoration in Connection with Dredging (Section 204, Water Resources Development Act of 1992)	The Corps of Engineers may carry out projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with dredging for construction, operation, or maintenance of an authorized Federal navigation project.	N/A
Emergency Streambank and Shoreline Erosion Protection (Section 14, Flood Control Act of 1946, as amended)	This provides protection from streambank or shoreline erosion to public facilities by the construction or repair of protection works.	\$1,000,000
Flood Control (Section 205, Flood Control Act of 1948, as amended)	The Corps may may implement structural and non-structural measures for flood risk management.	\$7,000,000
Mitigation of Shore Erosion Damage due to Federal Navigation (Section 111, River and Harbor Act of 1968, as amended)	The Corps of Engineers is authorized to investigate, study, and construct projects for the prevention or mitigation of shore damage attributable to Federal navigation works. The study will address structural or nonstructural measures to reduce erosion-type damage by shoreline stabilization.	\$5,000,000
Navigation (Section 107, River and Harbor Act of 1960, as amended)	Small Navigation Projects. This authorizes construction, operation and maintenance of small river and harbor improvement projects.	\$4,000,000
Project Modifications for Improving the Quality of the Environment (Section 1135(b), Water Resources Development Act of 1986, as amended)	This provides for constructing environmental restoration projects where a USACE project contributed to the degradation of the environment.	\$5,000,000
Snagging and Clearing for Flood Control (Section 208, Flood Control Act of 1954, as amended)	the Corps of Engineers is authorized under this Act to allot up to \$500,000 on any single tributary during any fiscal year for the removal of accumulated snags and other debris, and for the clearing or channel excavation and improvement with limited embankment construction by use of materials from the channel excavation.	\$500,000

¹See www.usace.army.mil/CECW/PlanningCOP/Pages/planlib.aspx for local cost sharing requirements.



C. Project Team and Contributing Authors

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Appendix D. Summary of Maumee Bay potential actions.

Description:	Potential Sponsors	Costs Estimate	Time Frame
Section 3. Flood Risk Management, Flood Control, Water Supply, Sedimentation and Stream Bank Erosion			
Control shoreline erosion at Maumee Bay State Park.	Maumee Bay State Park	\$500,000	2010-2012
Implement pilot studies related to shore erosion.	ODNR	\$50,000	2010-2014
Finalize Lake Erie Shore Erosion Management Plan.	ODNR	\$25,000	2010-2012
Publish coastal design manual.	ODNR	\$10,000	2010
Section 4. Water Quality			
Reduce/eliminate impacts of CSOs and SSOs.	City of Toledo	\$0	2008-10 yr
Promote precision application of fertilizer/ manure to reduce excess nitrate runoff.	County SWCD	\$0	2010-2014
Develop comprehensive nutrient management plans for all livestock farms that are not regulated by EPA/Ohio Dept of Agriculture.	NRCS	\$0	2010-2014
Provide agricultural BMP incentives to reduce sediment and nutrient transport to streams.	NRCS	\$0	2010-2014
An extension of a roadway into the Bay near Point Place is negatively impacting circulation. Removal or cut through should be evaluated.	ODOT	\$50,000	2012
Study the thermal impacts of the two Power plants (Consumers and Bay Shore), and the impacts of the fish kills on the fish populations from the kills at the Bayshore/First Energy and Consumers Whiting and DTE in Monroe should be reviewed.	OEPA	\$50,000	2010-2012
Water Quality Dynamics in the Western Basin of Lake Erie and Maumee Bay and Western Lake Erie Water Quality Monitoring.	University of Toledo	\$750,000	2010-2014
Investigation into nutrients (including phosphorous and nitrates) and lyngbya and other forms of algae.	USEPA	\$50,000	2010
Prepare watershed action plan to establish restoration priorities, funding sources and schedule.	Watershed Groups	\$0	2010
Section 5. Resource Based Recreation			
Construct new boat access and mooring facilities.	ODNR	\$100,000	2012
Quantify the relationship and connection between tourism and water quality and ecological functioning to assess how future dollars are spent.	Ohio State Parks	\$75,000	2011-2014
Section 6. Fish and Wildlife Habitat			
Conduct an assessment of Woodtick Peninsula and the Erie March Preserve including the potential use of geotubes to protect the area from further erosion.	ODNR	\$50,000	2011
RSM Demonstration	USACE	\$650,000	2010-2011
Develop and apply computer models to assess water quality and ecological impacts of pollutant loadings and invasive species.	USEPA	\$75,000	2013
Section 7. Commercial and Recreational Navigation			
Construct transient slips.	City and private marinas	\$100,000	2010-2012



Appendix D. Summary of Maumee Bay potential actions.

Description:	Potential Sponsors	Costs Estimate	Time Frame
Use CDFs for recreational, wildlife habitat and other uses.	ODNR	\$0	2012-2016
Study to evaluate realignment of navigation channel.	Toledo-Lucas County Port Authority	\$100,000	2012
Investigate short sea shipping opportunities.	Toledo-Lucas County Port Authority	\$75,000	2012
Maintenance Dredging, Primary and Backlog.	USACE	\$19,530,000	2009-2011
Section 3. Flood Risk Management, Flood Control, Water Supply, Sedimentation and Stream Bank Erosion			
Control shoreline erosion at Maumee Bay State Park	Maumee Bay State Park	\$500,000	2010-2012
Finalize Lake Erie Shore Erosion Management Plan	ODNR	\$25,000	2010-2012
Implement pilot studies related to shore erosion	ODNR	\$50,000	2010-2014
Publish a coastal design manual	ODNR	\$10,000	2010
Section 4. Water Quality			
Reduce/eliminate impacts of CSOs and SSOs	Toledo and other CSO/ SSO communities	\$220,400,000	2008-2010
Provide agricultural BMP incentives to reduce sediment and nutrient transport to streams.	NRCS	See specific watershed assessments	2010-2014
Prepare watershed action plan to establish restoration priorities, funding sources and schedule	Watershed Groups	See specific watershed assessments	2010
Develop comprehensive nutrient management plans for all livestock farms	NRCS, Soil and Water Conservation Services	See specific watershed assessments	2010-2014
Promote precision application of fertilizer/ manure to reduce excess nitrate runoff	County Soil and Water Conservation Service	See specific watershed assessments	2010-2014
Water Quality Dynamics in the Western Basin of Lake Erie and Maumee Bay and Western Lake Erie Water Quality Monitoring.	University of Toledo/ others	\$750,000	2010-2014
An extension of a roadway into the Bay near Point Place is negatively impacting circulation. Removal or cut through should be evaluated.	ODOT	\$50,000	2012
Study the thermal impacts of the two Power plants (Consumers and Bay Shore), and the impacts of the fish kills on the fish populations from the kills at the Bayshore/First Energy and Consumers Whiting and DTE in Monroe should be reviewed.	OEPA, ODNR, US EPA	\$50,000	2010-2012
Investigation into nutrients (including phosphorous and nitrates) and <i>Lyngbya</i> and other forms of algae.	US EPA, NOAA, OEPA, ODNR, MDEQ, MDNR	\$750,000	2010-2014



Appendix D. Summary of Maumee Bay potential actions.

Description:	Potential Sponsors	Costs Estimate	Time Frame
<i>Section 5. Resource Based Recreation</i>			
Quantify the relationship and connection between tourism and water quality and ecological functioning to assess how future dollars are spent.	Ohio State Parks, Ohio Sea Grant, ODNR	\$75,000	2010-2014
Construct new boat access and mooring facilities.	ODNR	\$100,000	2012
<i>Section 6. Fish and Wildlife Habitat</i>			
Conduct an assessment of Woodtick Peninsula and the Erie March Preserve including the potential use of geotubes to protect the area from further erosion.	ODNR	\$50,000	2011
Complete RSM demonstration project	USACE	\$650,000	
Develop and apply computer models to assess water quality and ecological impacts of pollutant loadings and invasive species.	USEPA	\$75,000	2013
<i>Section 7. Commercial and Recreational Navigation</i>			
Construct transient slips.	City and private marinas	\$100,000	2010-2012
Use CDFs for recreational, wild life habitat and other uses.	ODNR	See Lower Maumee Assessment	2012-2016
Study to evaluate realignment of navigation channel.	Toledo-Lucas County Port Authority	\$100,000	2012
Investigate short sea shipping opportunities.	Toledo-Lucas County Port Authority	\$75,000	2012
Maintenance Dredging, Primary and Backlog	USACE	\$19,530,000	2009-2011